Minnesota

Montana

North Dakota

South Dakota

REGIONAL
QUALITY
REPORT
2003

# U.S. Hard Red Spring Wheat

# the aristocrat of wheat

Hard red spring —a specialty wheat grown primarily in the Northern Plains of the United States —stands out as the aristocrat of wheat when it comes to baking bread. The high protein content and superior gluten quality of hard red spring wheat make it ideal for use in some of the world's finest baked goods. Yeast breads, hard rolls and specialty products such as hearth breads, whole grain breads, bagels and pizza crusts look and taste their best when baked with top quality spring wheat flour. Even frozen dough products are better with spring wheat because they can be stored longer than those made with lower protein wheats.

Flour mills in the United States and around the world also use hard red spring wheat extensively as a blending wheat to increase the gluten strength in a batch of flour. Adding hard red spring to lower protein wheat improves dough handling and mixing characteristics as well as water absorption. The resulting flour can be used to make an assortment of bread products as well as Chinese-type noodles.

TABLE OF CONTENTS



*Cover photo: Lois Bednar, Cooperstown, N.D.*

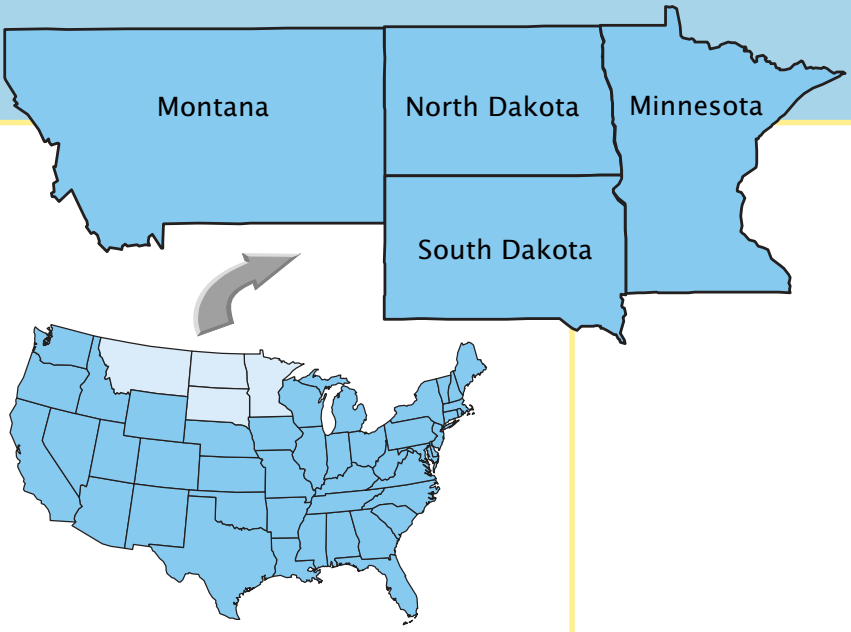
## 2003 OVERVIEW

The 2003 hard red spring wheat crop exhibits superb quality factors and is about 45 percent larger than last year's drought impacted crop. Despite a 12 percent reduction in planted area, a near ideal growing season in most of the region kept harvested area larger than in 2002 and yields nearly 50 percent better.

The regional crop's average grade is No. 1 Dark Northern Spring with 83 percent grading No. 1 and only 9 percent lower than a No. 2. The high grade profile is due to high average test weights, very low damaged kernel levels and high vitreous kernel content. The 2003 average test weight, at 61.3 pounds per bushel (80.6 kg/hl), is considerably higher than the five-year average and the best in several years. The average wheat protein content of 14.1 percent is lower than 2002, but still near the five-year average. A rapid, dry harvest allowed for an average falling number value of 404 seconds, reflecting an extremely sound crop. As in 2002, the varieties planted and a drier summer virtually eliminated crop diseases.

The milling and baking performance of the crop shows average flour extraction with above-average dough strength, absorption and loaf volume. In dough and bake tests, the crop boasts the highest absorption in more than five years. Although average dough strength is slightly weaker than 2002, the crop is still strong with a 7.0 farinogram classification (on a scale of 1 to 8). Loaf volume is slightly lower than last year, but higher than average. The bake tests indicate improved color, grain and texture.

Buyers will be pleased with the overall performance of the 2003 hard red spring wheat crop. As with most years, there are quality differences between growing locations. This year, continued drought conditions in the very western portion of the region produced notable differences in test weight, kernel size distribution, wheat protein content and flour extraction, as compared to the east. Buyers are always encouraged to use contract specifications that best meet their quality and value needs.




## SEASONAL CONDITIONS

**PLANTING** began in early April, making quick progress with nearly 50 percent of the crop planted by the month's end, far ahead of the five-year average of 30 percent. Planting stalled during mid-May when widespread and significant rain fell across the region. This slowed planting in northern areas, but the moisture was welcomed. Despite the delay, nearly 90 percent of the crop was planted by the end of May, equal to the five-year average. Half of the crop had emerged by May 20.

**GROWING** conditions in June were near ideal for early seeded wheat and germination of the later planted crop with favorable moisture and temperature patterns. Beneficial rains enhanced yield potential in nearly all areas. However, by June's end, the crop in western areas was becoming stressed as hot temperatures were common and precipitation diminished. Conditions in central and eastern locations remained favorable, as earlier maturity, cooler temperatures and adequate subsoil moisture aided crop development. An overall drier weather pattern almost entirely eliminated disease pressure.

July continued to be hot and dry. A lack of subsoil moisture hampered final yields in western areas. Sporadic rain and lower daytime temperatures minimized crop stress in eastern areas.

**HARVEST** began in late July and moved swiftly north, as hot, dry conditions hastened crop maturity. By August 11, roughly one-quarter of the crop was harvested, advancing to nearly 95 percent complete by the first week in September. The ideal conditions allowed farmers to harvest a high quality, sound crop in a time frame two to three weeks ahead of normal.

## HARD RED SPRING WHEAT PRODUCTION

| | 2002 | 2003 | 1998-02 AVERAGE |
|---|---|---|---|
| **MILLION BUSHELS** | | | |
| Minnesota | 61.2 | 104.4 | 78.6 |
| Montana | 75.9 | 59.4 | 87.0 |
| North Dakota | 165.2 | 252.8 | 202.6 |
| South Dakota | 24.0 | 56.3 | 53.5 |
| **Regional Total** | **326.3** | **472.9** | **421.7** |
| **U.S. Total** | **353.7** | **499.9** | **454.4** |
| **MILLION METRIC TONS** | | | |
| Minnesota | 1.66 | 2.84 | 2.14 |
| Montana | 2.07 | 1.62 | 2.37 |
| North Dakota | 4.50 | 6.88 | 5.51 |
| South Dakota | 0.65 | 1.53 | 1.46 |
| **Regional Total** | **8.88** | **12.87** | **11.48** |
| **U.S. Total** | **9.63** | **13.60** | **12.37** |

*Source: USDA September 2003 Small Grains Summary*

# wheat characteristics

Wheat grades, as defined by the Federal Grain Inspection Service (FGIS) of the USDA Grain Inspection, Packers and Stockyards Administration (GIPSA), reflect the general quality and condition of a representative sample. U.S. grades are based on test weight and include limits on damaged kernels, foreign material, shrunken and broken kernels, and wheat of contrasting classes. Each determination is made on the basis of the grain when free from dockage and shrunken and broken kernels.

## SUBCLASSES

Subclass is a separate marketing factor based on the number of kernels with a complete, hard and vitreous endosperm, the portion that makes flour. For hard red spring wheat the subclasses are:

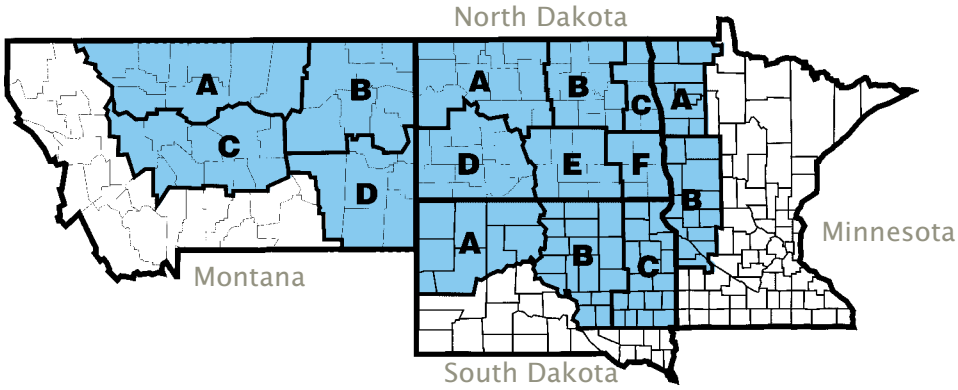
- **Dark Northern Spring (DNS)**—at least 75 percent or more dark, hard, vitreous kernels;
- **Northern Spring (NS)**—between 25 and 74 percent dark, hard, vitreous kernels;
- **Red Spring (RS)**—less than 25 percent dark, hard, vitreous kernels.

## OFFICIAL U.S. GRADES AND GRADE REQUIREMENTS (Revised June 1993)

| | U.S. GRADES | | | | |
|---|---|---|---|---|---|
| GRADING FACTORS | 1 | 2 | 3 | 4 | 5 |
| **HARD RED SPRING—MINIMUM TEST WEIGHTS** | | | | | |
| Pounds per bushel | 58.0 | 57.0 | 55.0 | 53.0 | 50.0 |
| Kilograms per hectoliter | 76.4 | 75.1 | 72.5 | 69.9 | 66.0 |
| **MAXIMUM PERCENT LIMITS OF:** | | | | | |
| **Defects** | | | | | |
| Damaged kernels | | | | | |
| Heat (part of total) | 0.2 | 0.2 | 0.5 | 1.0 | 3.0 |
| Total | 2.0 | 4.0 | 7.0 | 10.0 | 15.0 |
| Foreign material | 0.4 | 0.7 | 1.3 | 3.0 | 5.0 |
| Shrunken/ broken kernels | 3.0 | 5.0 | 8.0 | 12.0 | 20.0 |
| Total[1] | 3.0 | 5.0 | 8.0 | 12.0 | 20.0 |
| **Wheat of other classes**[2] | | | | | |
| Contrasting classes | 1.0 | 2.0 | 3.0 | 10.0 | 10.0 |
| Total[3] | 3.0 | 5.0 | 10.0 | 10.0 | 10.0 |
| **Stones** | 0.1 | 0.1 | 0.1 | 0.1 | 0.1 |
| **MAXIMUM COUNT LIMITS OF:** | | | | | |
| **Other material** | | | | | |
| Animal filth | 1 | 1 | 1 | 1 | 1 |
| Castor beans | 1 | 1 | 1 | 1 | 1 |
| Crotalaria seeds | 2 | 2 | 2 | 2 | 2 |
| Glass | 0 | 0 | 0 | 0 | 0 |
| Stones | 3 | 3 | 3 | 3 | 3 |
| Unknown foreign substances | 3 | 3 | 3 | 3 | 3 |
| Total[4] | 4 | 4 | 4 | 4 | 4 |
| **Insect-damaged kernels in 100 grams** | 31 | 31 | 31 | 31 | 31 |

U.S. Sample grade is wheat that:
(a) Does not meet the requirements for U.S. Nos. 1, 2, 3, 4, or 5; or
(b) Has a musty, sour, or commercially objectionable foreign odor (except smut or garlic odor); or
(c) is heating or of distinctly low quality.
1 Includes damaged kernels (total), foreign material, and shrunken and broken kernels.
2 Unclassed wheat of any grade may contain not more than 10.0 percent of wheat of other classes.
3 Includes contrasting classes.

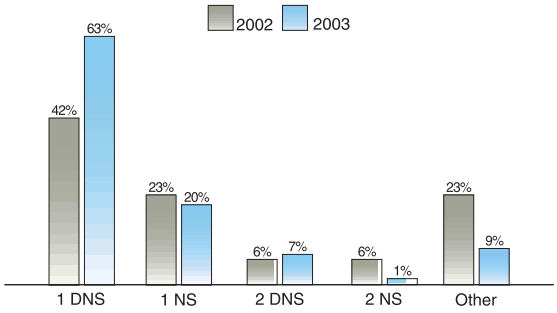
Wheat samples were obtained in Montana, North Dakota, South Dakota and Minnesota in the crop reporting areas identified in color. Samples were gathered during harvest from growers, farm bins and country elevators.



## OVERALL GRADE

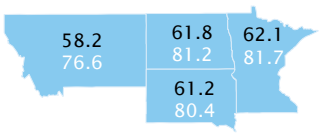
The average grade for the region is 1DNS. This grade reflects the average vitreous kernel content of 81percent. Of the 15 composite samples, eight graded 1DNS, four graded 1NS, two graded 2DNS and one graded 3DNS.

### REGIONAL GRADE DISTRIBUTION



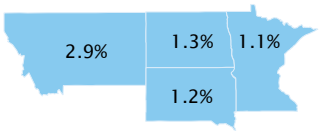

Eighty-three percent of 2003 samples grade No. 1NS or better, up from 65 percent last year.

### TEST WEIGHT BY STATE

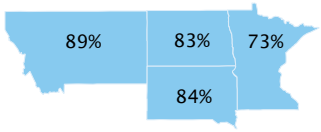



pounds/bushel
kilograms/hectoliter

### AVERAGE TOTAL DEFECTS BY STATE




### AVERAGE VITREOUS KERNELS BY STATE

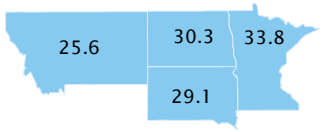



# Wheat Grading Data

| STATE AND CROP REPORTING AREA | TEST WEIGHT LBS/BU | TEST WEIGHT KG/HL | DAMAGE % | FOREIGN MATERIAL % | SHRUNKEN/ BROKEN KERNELS % | TOTAL DEFECTS % | CONTRASTING CLASSES % | U.S. GRADE | VITREOUS KERNELS % |
|---|---|---|---|---|---|---|---|---|---|
| **MINNESOTA** | | | | | | | | | |
| Area A | 62.8 | 82.6 | 0.3 | 0.0 | 0.5 | 0.8 | 0.0 | 1DNS | 79 |
| Area B | 61.4 | 80.7 | 0.6 | 0.0 | 0.7 | 1.3 | 0.0 | 1NS | 67 |
| State Avg. 2003 | 62.1 | 81.7 | 0.5 | 0.0 | 0.6 | 1.1 | 0.0 | 1NS | 73 |
| State Avg. 2002 | 58.6 | 77.2 | 0.8 | 0.0 | 1.3 | 2.0 | 0.4 | 1NS | 55 |
| **MONTANA** | | | | | | | | | |
| Area A | 57.0 | 75.1 | 0.0 | 0.0 | 2.6 | 2.6 | 0.0 | 2DNS | 96 |
| Area B | 60.3 | 79.3 | 0.0 | 0.0 | 2.4 | 2.4 | 0.0 | 1DNS | 82 |
| Area C | 56.4 | 74.3 | 0.2 | 0.0 | 3.2 | 3.4 | 2.6 | 3DNS | 87 |
| Area D | 59.0 | 77.6 | 0.0 | 0.0 | 3.2 | 3.2 | 0.0 | 2DNS | 92 |
| State Avg. 2003 | 58.2 | 76.6 | 0.1 | 0.0 | 2.8 | 2.9 | 0.7 | 2DNS | 89 |
| State Avg. 2002 | 59.4 | 78.2 | 0.3 | 0.0 | 1.7 | 1.9 | 0.0 | 1DNS | 83 |
| **NORTH DAKOTA** | | | | | | | | | |
| Area A | 62.1 | 81.7 | 0.3 | 0.0 | 1.2 | 1.5 | 0.0 | 1DNS | 90 |
| Area B | 62.6 | 82.3 | 0.0 | 0.0 | 0.8 | 0.8 | 0.4 | 1DNS | 89 |
| Area C | 62.4 | 82.0 | 0.6 | 0.0 | 0.5 | 1.1 | 0.0 | 1NS | 68 |
| Area D | 60.0 | 78.9 | 0.1 | 0.0 | 1.8 | 1.9 | 0.0 | 1DNS | 97 |
| Area E | 62.6 | 82.3 | 0.1 | 0.0 | 1.0 | 1.1 | 0.0 | 1DNS | 87 |
| Area F | 61.0 | 80.2 | 0.9 | 0.0 | 0.5 | 1.4 | 0.0 | 1NS | 64 |
| State Avg. 2003 | 61.8 | 81.2 | 0.3 | 0.0 | 1.0 | 1.3 | 0.1 | 1DNS | 83 |
| State Avg. 2002 | 59.3 | 78.1 | 0.9 | 0.0 | 1.6 | 2.5 | 0.0 | 1NS | 73 |
| **SOUTH DAKOTA** | | | | | | | | | |
| Area A | 60.6 | 79.7 | 0.0 | 0.0 | 1.0 | 1.0 | 0.0 | 1DNS | 98 |
| Area B | 61.7 | 81.1 | 0.4 | 0.0 | 1.1 | 1.5 | 0.0 | 1DNS | 85 |
| Area C | 61.2 | 80.5 | 0.1 | 0.0 | 0.9 | 1.0 | 0.0 | 1NS | 68 |
| State Avg. 2003 | 61.2 | 80.4 | 0.2 | 0.0 | 1.0 | 1.2 | 0.0 | 1DNS | 84 |
| State Avg. 2002 | 58.3 | 76.8 | 0.3 | 0.0 | 1.6 | 1.9 | 0.0 | 1NS | 58 |
| **FOUR-STATE REGION** | | | | | | | | | |
| Avg. 2003 | 61.3 | 80.6 | 0.3 | 0.0 | 1.1 | 1.4 | 0.1 | 1DNS | 81 |
| Avg. 2002 | 59.1 | 77.8 | 0.6 | 0.0 | 1.5 | 2.2 | 0.1 | 1NS | 71 |
| Five-Year Avg. | 59.6 | 78.5 | 0.6 | 0.0 | 1.7 | 2.3 | 0.0 | 1NS | 70 |

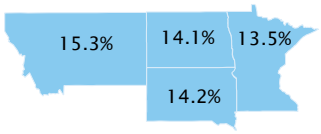
*All state and regional averages have been adjusted to reflect production differences.*

## THOUSAND KERNEL WEIGHT BY STATE



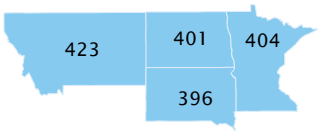

grams

## AVERAGE PROTEIN BY STATE



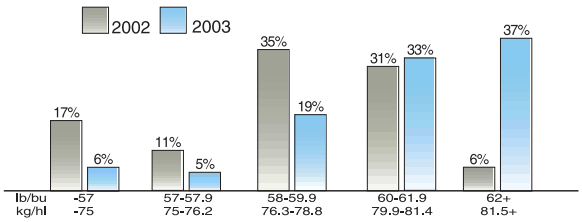

12% Moisture

## AVERAGE FALLING NUMBER BY STATE



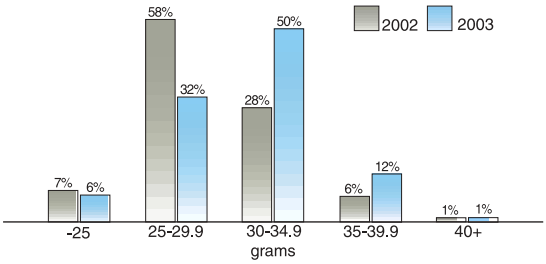

Seconds

## REGIONAL TEST WEIGHT DISTRIBUTION



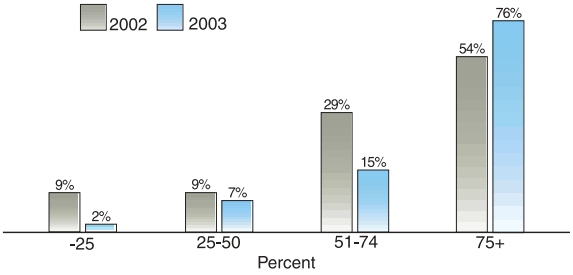

Eighty-nine percent of 2003 samples have test weights of 58 lbs/bu (76.3 kg/hl) or greater. The regional average test weight is 61.3 lbs/bu (80.6 kg/hl), up significantly from last year.

## REGIONAL THOUSAND KERNEL WEIGHT DISTRIBUTION



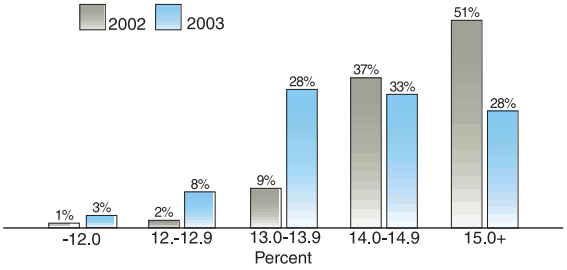

Sixty-two percent of 2003 samples have a thousand kernel weight of 30 grams or more. The regional average is 30.3 grams.

## REGIONAL VITREOUS KERNEL DISTRIBUTION



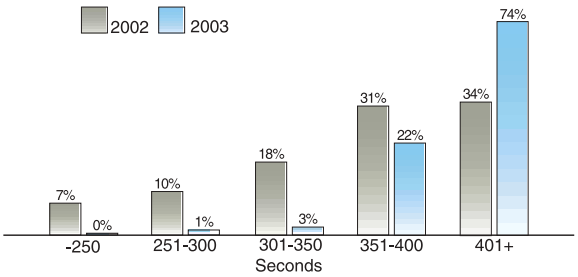

Seventy-six percent of 2003 samples have a dark, hard vitreous kernel count of 75 percent or better, up from 54 percent last year.

## REGIONAL PROTEIN DISTRIBUTION (12% moisture basis)



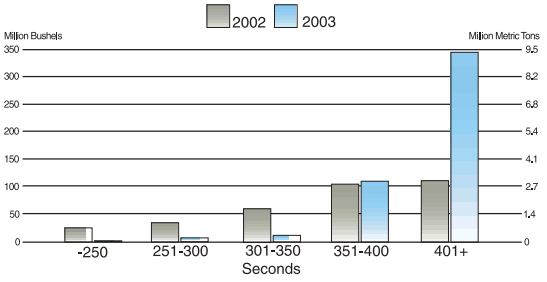

Sixty-one percent of 2003 samples have a protein content of 14.0 percent or greater.

## REGIONAL FALLING NUMBER DISTRIBUTION



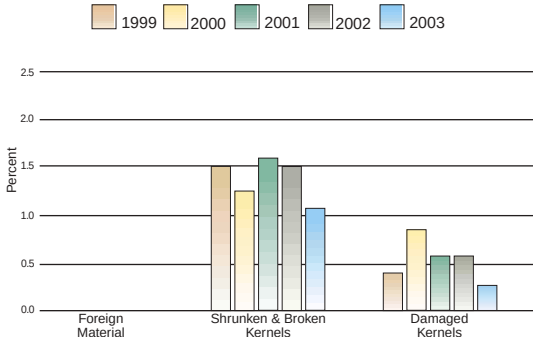

Ninety-nine percent of the 2003 crop has a falling number of 300 seconds or greater, indicating a very sound crop.

## REGIONAL QUANTITY ESTIMATES BY FALLING NUMBER RANGE



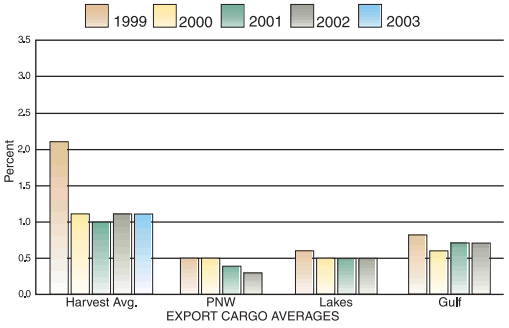

An estimated 465 million bushels (12.7 million metric tons) of the 2003 regional crop have a falling number greater than 300 seconds.

## REGIONAL AVERAGE: TOTAL DEFECTS



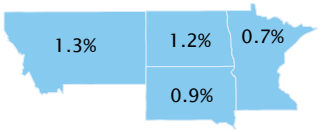

Average total defects are 1.4 percent, down from 2.1 percent last year, reflecting the disease-free nature of the crop.

## REGIONAL AVERAGE DOCKAGE CONTENT

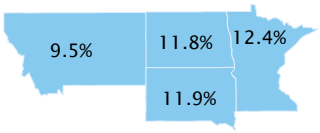



Dockage in the 2003 harvest averages 1.1 percent. Cleaning and contract specifications help reduce dockage in export shipments.

## AVERAGE HARVEST DOCKAGE BY STATE




## AVERAGE MOISTURE BY STATE



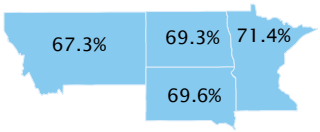

# Other Kernel Quality Data

| STATE AND CROP REPORTING AREA | DOCKAGE % | MOISTURE % | 1000 KERNEL WEIGHT G | KERNEL DIST. MEDIUM % | KERNEL DIST. LARGE % | PROTEIN (DRY MATTER) % | PROTEIN (12% MOISTURE) % | WHEAT ASH % | FALLING NUMBER (SEC) | ZELENY SEDIMENT-ATION (CC) |
|---|---|---|---|---|---|---|---|---|---|---|
| **MINNESOTA** | | | | | | | | | | |
| Area A | 0.8 | 12.0 | 34.4 | 22 | 74 | 15.2 | 13.4 | 1.54 | 400 | 57 |
| Area B | 0.5 | 12.7 | 33.2 | 23 | 73 | 15.3 | 13.5 | 1.63 | 408 | 57 |
| State Avg. 2003 | 0.7 | 12.4 | 33.8 | 22.5 | 73.5 | 15.3 | 13.5 | 1.59 | 404 | 57 |
| State Avg. 2002 | 0.9 | 12.9 | 27.8 | 45 | 43.5 | 16.8 | 14.8 | 1.79 | 294 | 63 |
| **MONTANA** | | | | | | | | | | |
| Area A | 1.2 | 10.0 | 24.1 | 67 | 14 | 18.0 | 15.8 | 1.67 | 401 | 56 |
| Area B | 1.4 | 9.4 | 27.9 | 55 | 33 | 16.0 | 14.1 | 1.59 | 436 | 44 |
| Area C | 1.7 | 8.8 | 22.8 | 57 | 14 | 19.1 | 16.8 | 1.76 | 446 | 48 |
| Area D | 0.9 | 9.7 | 27.7 | 50 | 36 | 16.5 | 14.5 | 1.63 | 410 | 49 |
| State Avg. 2003 | 1.3 | 9.5 | 25.6 | 57.3 | 24.3 | 17.4 | 15.3 | 1.66 | 423 | 49 |
| State Avg. 2002 | 1.1 | 12.1 | 28.6 | 42.0 | 48.8 | 17.3 | 15.2 | 1.59 | 365 | 65 |
| **NORTH DAKOTA** | | | | | | | | | | |
| Area A | 1.1 | 10.8 | 29.3 | 42 | 52 | 16.5 | 14.5 | 1.47 | 402 | 59 |
| Area B | 1.4 | 12.0 | 31.1 | 28 | 68 | 15.6 | 13.7 | 1.56 | 383 | 60 |
| Area C | 0.6 | 12.5 | 33.1 | 23 | 74 | 15.6 | 13.7 | 1.64 | 405 | 58 |
| Area D | 1.4 | 10.5 | 26.1 | 57 | 27 | 17.4 | 15.3 | 1.57 | 395 | 59 |
| Area E | 2.1 | 11.7 | 30.9 | 36 | 57 | 15.5 | 13.6 | 1.64 | 404 | 54 |
| Area F | 0.6 | 13.1 | 31.2 | 29 | 67 | 15.6 | 13.7 | 1.62 | 416 | 58 |
| State Avg. 2003 | 1.2 | 11.8 | 30.3 | 35.8 | 57.5 | 16.0 | 14.1 | 1.58 | 401 | 58 |
| State Avg. 2002 | 1.3 | 12.5 | 29.5 | 45.8 | 45.0 | 17.4 | 15.4 | 1.69 | 322 | 61 |
| **SOUTH DAKOTA** | | | | | | | | | | |
| Area A | 1.3 | 11.1 | 27.2 | 61 | 29 | 17.7 | 15.6 | 1.66 | 404 | 58 |
| Area B | 0.7 | 11.8 | 29.2 | 45 | 51 | 15.6 | 13.7 | 1.68 | 403 | 52 |
| Area C | 0.6 | 12.7 | 30.9 | 33 | 60 | 15.2 | 13.4 | 1.67 | 382 | 51 |
| State Avg. 2003 | 0.9 | 11.9 | 29.1 | 46.3 | 46.7 | 16.2 | 14.2 | 1.67 | 396 | 54 |
| State Avg. 2002 | 0.9 | 12.5 | 25.6 | 55.0 | 30.0 | 18.5 | 16.2 | 1.66 | 413 | 57 |
| **FOUR-STATE REGION** | | | | | | | | | | |
| Avg. 2003 | 1.1 | 11.6 | 30.3 | 36.8 | 55.6 | 16.0 | 14.1 | 1.60 | 404 | 56 |
| Avg. 2002 | 1.1 | 12.5 | 28.7 | 45.4 | 44.6 | 17.4 | 15.3 | 1.68 | 334 | 62 |
| Five-Year Avg. | 1.3 | 11.9 | 30.3 | 38 | 55 | 16.5 | 14.5 | 1.68 | 368 | 52 |

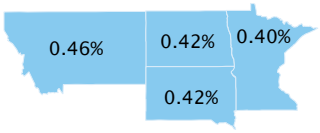
*All state and regional averages have been adjusted to reflect production differences.*

# milling characteristics

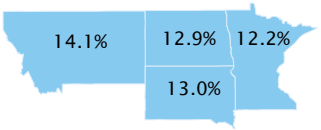
AVERAGE FLOUR EXTRACTION BY STATE




AVERAGE FLOUR ASH CONTENT BY STATE

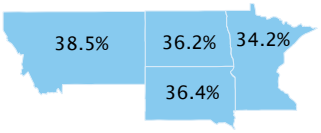



AVERAGE FLOUR PROTEIN CONTENT BY STATE




14% Moisture

AVERAGE WET GLUTEN CONTENT BY STATE




14% Moisture

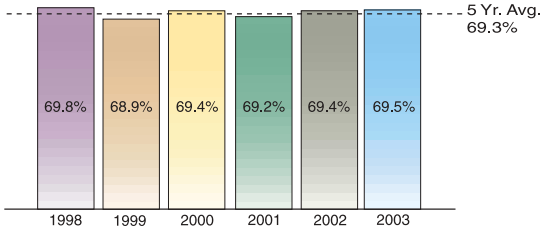
Flour is evaluated for several factors to determine overall milling efficiency, grade, soundness and functional properties.

Extraction, or the proportion of the wheat kernel that can be milled into flour, is important to mill profitability. For purposes of this survey, test milling was conducted with a Buhler laboratory mill. Results are suitable for comparison between crop years, however yields are lower than those obtained in commercial mills. Another measure of milling efficiency and of flour grade is the ash content, or mineral residue, remaining after incineration of a sample. The lower the ash, the whiter and more refined the flour.

Falling number indicates the soundness or alpha-amylase activity in wheat or flour. A high falling number indicates low enzyme activity, while low falling numbers indicate high activity associated with sprout damage. Amylograph peak viscosity is another measure of alpha-amylase activity.

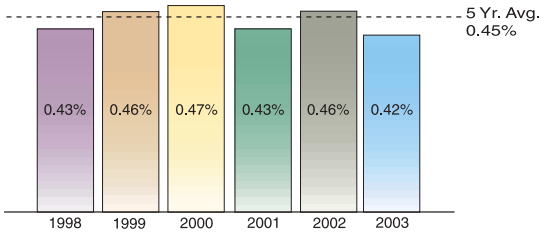
Wet gluten provides a quantitative measure of the gluten forming proteins in flour that are primarily responsible for its dough mixing and baking properties.

REGIONAL AVERAGE: FLOUR EXTRACTION



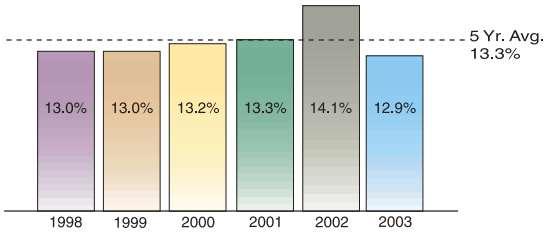

The regional average extraction is 69.5 percent, similar to last year and the five-year average.

REGIONAL AVERAGE: ASH CONTENT



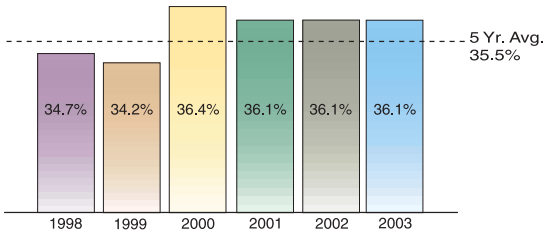

The 2003 crop produced flour with an ash content of 0.42 percent.

REGIONAL AVERAGE: FLOUR PROTEIN CONTENT



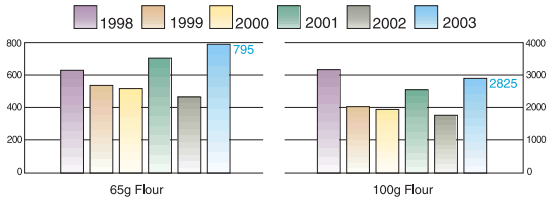

The 2003 crop produced a flour protein content of 12.9 percent, lower than last year and the five-year average.

REGIONAL AVERAGE: WET GLUTEN




Average wet gluten content for the 2003 crop is 36.1 percent, better than the five-year average.

REGIONAL AVERAGE
AMYLOGRAPH PEAK VISCOSITY
(Brabender Units)




Peak viscosity averages for 2003 are improved, reflecting the overall soundness of the crop.

*Photo credit: Wheat Foods Council*

# Flour Quality Data

| STATE AND CROP REPORTING AREA | FLOUR EXTRACTION % | FLOUR ASH % | FLOUR PROTEIN (14% MOISTURE) % | WET GLUTEN % | FALLING NUMBER SEC | AMYLOGRAPH PEAK VISCOSITY 65G FL B.U. | AMYLOGRAPH PEAK VISCOSITY 100G FL B.U. |
|---|---|---|---|---|---|---|---|
| **MINNESOTA** | | | | | | | |
| Area A | 71.0 | 0.41 | 12.2 | 34.4 | 436 | 805 | 2755 |
| Area B | 71.8 | 0.38 | 12.2 | 34.0 | 412 | 745 | 2780 |
| State Avg. 2003 | 71.4 | 0.40 | 12.2 | 34.2 | 424 | 775 | 2768 |
| State Avg. 2002 | 70.7 | 0.46 | 13.5 | 33.3 | 342 | 345 | 1213 |
| **MONTANA** | | | | | | | |
| Area A | 68.0 | 0.47 | 14.7 | 40.2 | 426 | 790 | 3380 |
| Area B | 67.4 | 0.43 | 12.8 | 34.5 | 448 | 1070 | 3615 |
| Area C | 67.1 | 0.51 | 15.5 | 42.2 | 481 | 820 | 3290 |
| Area D | 66.6 | 0.43 | 13.4 | 36.9 | 426 | 940 | 3175 |
| State Avg. 2003 | 67.3 | 0.46 | 14.1 | 38.5 | 445 | 905 | 3365 |
| State Avg. 2002 | 68.1 | 0.43 | 14.0 | 36.4 | 422 | 599 | 2316 |
| **NORTH DAKOTA** | | | | | | | |
| Area A | 69.1 | 0.42 | 13.4 | 37.7 | 412 | 880 | 2930 |
| Area B | 69.4 | 0.43 | 12.5 | 35.7 | 398 | 570 | 1855 |
| Area C | 69.0 | 0.41 | 12.6 | 35.6 | 400 | 680 | 2395 |
| Area D | 67.3 | 0.43 | 14.0 | 39.6 | 432 | 900 | 3300 |
| Area E | 68.7 | 0.42 | 12.4 | 34.9 | 403 | 805 | 2810 |
| Area F | 72.1 | 0.41 | 12.3 | 33.9 | 443 | 710 | 2570 |
| State Avg. 2003 | 69.3 | 0.42 | 12.9 | 36.2 | 415 | 758 | 2643 |
| State Avg. 2002 | 69.5 | 0.47 | 14.2 | 36.8 | 358 | 453 | 1623 |
| **SOUTH DAKOTA** | | | | | | | |
| Area A | 67.7 | 0.45 | 14.5 | 41.4 | 437 | 915 | 3280 |
| Area B | 69.6 | 0.41 | 12.5 | 34.3 | 427 | 900 | 3320 |
| Area C | 71.5 | 0.40 | 12.1 | 33.4 | 397 | 845 | 2930 |
| State Avg. 2003 | 69.6 | 0.42 | 13.0 | 36.4 | 420 | 887 | 3177 |
| State Avg. 2002 | 70.1 | 0.47 | 15.0 | 37.8 | 426 | 693 | 2560 |
| **FOUR-STATE REGION** | | | | | | | |
| Average 2003 | 69.5 | 0.42 | 12.9 | 36.1 | 421 | 795 | 2825 |
| Average 2002 | 69.4 | 0.46 | 14.1 | 36.1 | 375 | 485 | 1783 |
| Five-Year Average | 69.3 | 0.45 | 13.3 | 35.5 | 392 | 588 | 2302 |

*All state and regional averages have been adjusted to reflect production differences.*

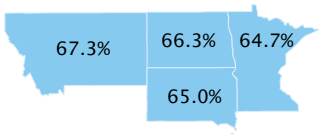
# dough characteristics

Photo credit: Wheat Foods Council

Physical characteristics of dough are evaluated to reveal useful information about variations in flour types, processing requirements and expected end-product quality.

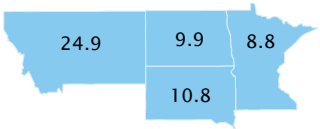
A farinograph traces a curve during the dough mixing process to record variations in gluten development and the breakdown of gluten proteins over time. The extensograph measures dough strength by stretching a piece of dough on a hook until it breaks. An alveograph traces a curve that measures air pressure necessary to inflate a piece of dough to the point of rupture.

AVERAGE FARINOGRAM ABSORPTION BY STATE



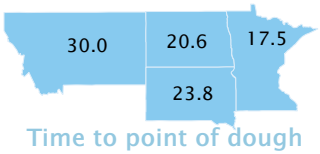

Water required to optimally develop dough.

AVERAGE PEAK TIME BY STATE (minutes)



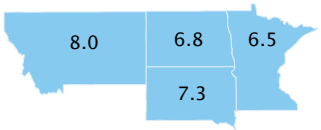

Time to optimal dough development.

AVERAGE STABILITY BY STATE (minutes)




Time to point of dough breakdown.

AVERAGE DOUGH STRENGTH BY STATE




Farinogram classification on a scale of 1 to 8 with higher values indicating strong mixing properties

## Physical Dough Properties

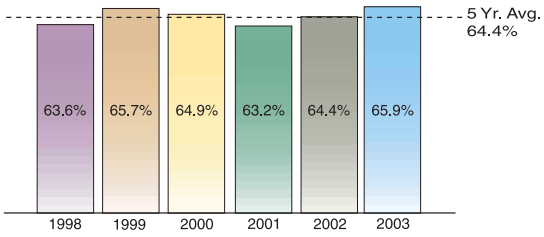
| | FARINOGRAM | | | | | |
|---|---|---|---|---|---|---|
| STATE AND CROP REPORTING AREA | ABSORPTION % | PEAK TIME MIN | STABILITY MIN | MTI B.U. | CLASSIFICATION[1] | VALORIMETER[2] |
| **MINNESOTA** | | | | | | |
| Area A | 65.4 | 8.5 | 15.5 | 20 | 6 | 74 |
| Area B | 63.9 | 9.0 | 19.5 | 20 | 7 | 76 |
| State Avg. 2003 | 64.7 | 8.8 | 17.5 | 20 | 6.5 | 75 |
| State Avg. 2002 | 61.8 | 8.5 | 16.0 | 25 | 6.5 | N/A |
| **MONTANA** | | | | | | |
| Area A | 67.3 | 27.5 | 26.0 | 5 | 8 | 100+ |
| Area B | 66.9 | 28.0 | 26.5 | 10 | 8 | 100+ |
| Area C | 68.2 | 31.0 | 41.5 | 5 | 8 | 100+ |
| Area D | 66.8 | 13.0 | 26.0 | 10 | 8 | 90 |
| State Avg. 2003 | 67.3 | 24.9 | 30.0 | 8 | 8 | 97.5 |
| State Avg. 2002 | 65.7 | 31.0 | 37.3 | 9 | 8 | N/A |
| **NORTH DAKOTA** | | | | | | |
| Area A | 67.6 | 10.0 | 24.0 | 10 | 7 | 82 |
| Area B | 67.6 | 9.0 | 16.5 | 20 | 6 | 76 |
| Area C | 66.9 | 10.0 | 18.0 | 20 | 7 | 78 |
| Area D | 66.1 | 12.0 | 31.0 | 10 | 8 | 86 |
| Area E | 66.2 | 8.5 | 15.0 | 20 | 6 | 74 |
| Area F | 63.3 | 10.0 | 19.0 | 25 | 7 | 78 |
| State Avg. 2003 | 66.3 | 9.9 | 20.6 | 18 | 6.8 | 79 |
| State Avg. 2002 | 64.7 | 10.0 | 20.4 | 21 | 7 | N/A |
| **SOUTH DAKOTA** | | | | | | |
| Area A | 68.0 | 13.0 | 27.5 | 5 | 8 | 84 |
| Area B | 64.5 | 11.0 | 28.0 | 10 | 8 | 80 |
| Area C | 62.4 | 8.5 | 16.0 | 20 | 6 | 76 |
| State Avg. 2003 | 65.0 | 10.8 | 23.8 | 12 | 7.3 | 80 |
| State Avg. 2002 | 64.2 | 10.8 | 29.5 | 10 | 8 | N/A |
| **FOUR-STATE REGION** | | | | | | |
| Avg. 2003 | 65.9 | 11.6 | 21.5 | 16 | 7 | 80.6 |
| Avg. 2002 | 64.4 | 14.8 | 24.3 | 18 | 7.2 | N/A |
| Five-Year Avg. | 64.4 | 12.1 | 19.1 | 24 | 6.4 | N/A |

*All state and regional averages have been adjusted to reflect production differences.*

*[1]See reference farinograms for hard red spring wheat on page 19.*

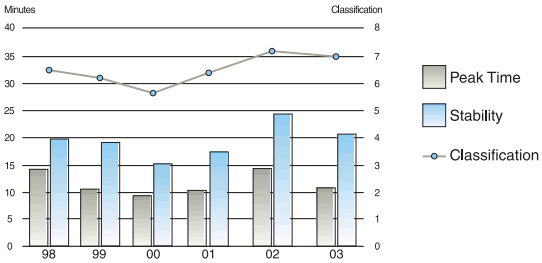
*[2]The maximum valorimeter value is 100. Three of the four Montana composite samples were stronger.*

## REGIONAL AVERAGE: FARINOGRAM ABSORPTION



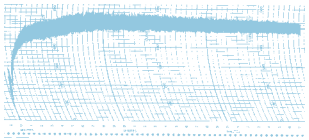

The regional absorption is 65.9 percent, up from 2002 and the five-year average.

## REGIONAL AVERAGE FARINOGRAM RESULTS



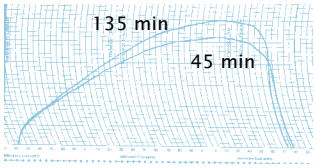

The regional average peak time is 11.6 minutes; stability, 21.5 minutes; and mixing tolerance index, 16 Brabender units; for an overall classification of 7.0 (on a 1 to 8 scale).

## REGIONAL AVERAGE FARINOGRAM



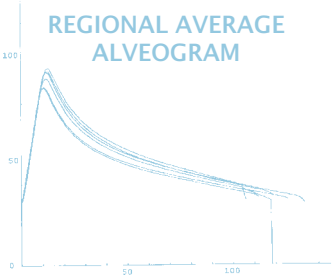
A 7.0 classification indicates strong mixing properties.

## REGIONAL AVERAGE EXTENSOGRAM




Indicates extensibility and resistance to extension. Area beneath curve indicates the energy or work required.

## REGIONAL AVERAGE ALVEOGRAM



P-Curve height shows maximum pressure needed to deform dough, indicating stability. L-Length of curve reflects extensibility. W-Measurement of total energy or work needed to inflate dough.

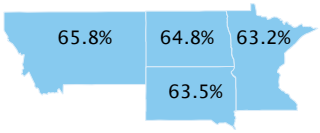
# Physical Dough Properties

| STATE AND CROP REPORTING AREA | EXTENSOGRAM | | | | | | ALVEOGRAM | | |
|---|---|---|---|---|---|---|---|---|---|
| | EXTENSIBILITY 45 MIN Cm | RESISTANCE 45 MIN B.U. | AREA sqcm | EXTENSIBILITY 135 MIN cm | RESISTANCE 135 MIN B.U. | AREA sq cm | P mm | L mm | W JoulesX10⁻⁴ |
| **MINNESOTA** | | | | | | | | | |
| Area A | 24.4 | 480 | 146 | 22.1 | 530 | 139 | 88 | 122 | 363 |
| Area B | 25.8 | 565 | 182 | 24.4 | 600 | 187 | 84 | 115 | 344 |
| State Avg. 2003 | 25.1 | 523 | 164 | 23.3 | 565 | 163 | 86 | 119 | 354 |
| State Avg. 2002 | 24.5 | 571 | 173 | N/A | N/A | N/A | 84 | 105 | 330 |
| **MONTANA** | | | | | | | | | |
| Area A | 24.3 | 610 | 182 | 21.9 | 690 | 191 | 103 | 113 | 444 |
| Area B | 21.5 | 650 | 165 | 20.4 | 790 | 209 | 111 | 90 | 388 |
| Area C | 24.4 | 600 | 178 | 22.6 | 700 | 198 | 114 | 109 | 483 |
| Area D | 21.5 | 550 | 149 | 19.3 | 665 | 162 | 104 | 91 | 357 |
| State Avg. 2003 | 22.9 | 603 | 169 | 21.1 | 711 | 190 | 108 | 101 | 418 |
| State Avg. 2002 | 24.0 | 566 | 167 | N/A | N/A | N/A | 96 | 117 | 420 |
| **NORTH DAKOTA** | | | | | | | | | |
| Area A | 23.5 | 525 | 153 | 23.3 | 600 | 173 | 103 | 109 | 403 |
| Area B | 22.5 | 450 | 126 | 21.4 | 500 | 134 | 105 | 109 | 392 |
| Area C | 25.8 | 460 | 152 | 24.5 | 480 | 150 | 98 | 118 | 394 |
| Area D | 22.3 | 490 | 145 | 21.2 | 600 | 156 | 94 | 120 | 392 |
| Area E | 22.3 | 430 | 118 | 21.4 | 530 | 146 | 96 | 126 | 405 |
| Area F | 23.5 | 570 | 170 | 20.6 | 605 | 155 | 86 | 133 | 382 |
| State Avg. 2003 | 23.3 | 488 | 144 | 22.1 | 553 | 152 | 97 | 119 | 395 |
| State Avg. 2002 | 25.0 | 515 | 162 | N/A | N/A | N/A | 90 | 117 | 381 |
| **SOUTH DAKOTA** | | | | | | | | | |
| Area A | 23.0 | 560 | 168 | 23.0 | 680 | 180 | 107 | 108 | 417 |
| Area B | 23.3 | 560 | 163 | 23.3 | 630 | 158 | 97 | 113 | 391 |
| Area C | 22.4 | 535 | 149 | 22.4 | 630 | 162 | 74 | 127 | 320 |
| State Avg. 2003 | 22.9 | 552 | 160 | 22.9 | 647 | 167 | 93 | 116 | 376 |
| State Avg. 2002 | 27.6 | 560 | 194 | N/A | N/A | N/A | 92 | 103 | 358 |
| **FOUR-STATE REGION** | | | | | | | | | |
| Avg. 2003 | 23.6 | 517 | 153 | 22.3 | 586 | 162 | 95 | 116 | 386 |
| Avg. 2002 | 24.9 | 538 | 167 | N/A | N/A | N/A | 90 | 114 | 380 |
| Five-Year Avg. | 23.0 | 475 | 137 | N/A | N/A | N/A | 92 | 111 | 360 |

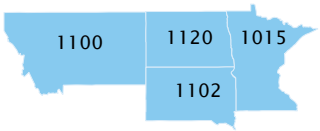
*All state and regional averages have been adjusted to reflect production differences.*

# baking characteristics

## AVERAGE BAKING ABSORPTION BY STATE



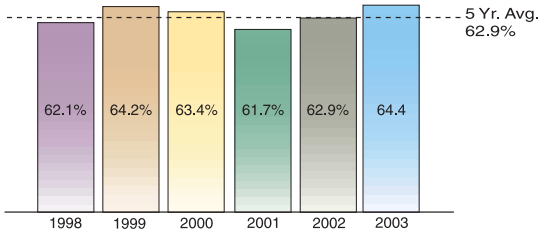

## AVERAGE LOAF VOLUME BY STATE




Cubic centimeters

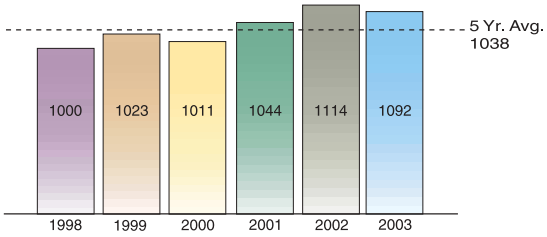
Although consumers make the ultimate judgement, baking tests are the final laboratory method for evaluating wheat quality. In general, a good correlation exists between loaf volume and protein quantity and quality. Laboratory technicians also visually evaluate test loaves for crumb grain, texture and color, as well as crust color and loaf symmetry.

## REGIONAL AVERAGE BAKING ABSORPTION




Average absorption for the four-state region is 64.4 percent.

## REGIONAL AVERAGE LOAF VOLUME (cubic centimeters)




Average loaf volume for the four-state region is 1092 cubic centimeters, up from the five-year average.

*Photo credit: USDA Agricultural Research Service*

*Photo credit: Wheat Foods Council*

# Baking Data

| STATE AND CROP REPORTING AREA | BAKING ABSORPTION % | DOUGH HANDLING PROPERTIES | LOAF VOLUME CC | GRAIN AND TEXTURE | CRUMB COLOR | CRUST COLOR | SYMMETRY |
|---|---|---|---|---|---|---|---|
| **MINNESOTA** | | | | | | | |
| Area A | 63.9 | 10.0 | 1000 | 8.5 | 8.5 | 10.0 | 10.0 |
| Area B | 62.4 | 10.0 | 1030 | 8.5 | 8.0 | 10.0 | 10.0 |
| State Avg. 2003 | 63.2 | 10.0 | 1015 | 8.5 | 8.3 | 10.0 | 10.0 |
| State Avg. 2002 | 60.3 | 10.0 | 1088 | 8.3 | 8.5 | 10.0 | 10.0 |
| **MONTANA** | | | | | | | |
| Area A | 65.8 | 10.0 | 1150 | 8.5 | 8.5 | 10.0 | 10.0 |
| Area B | 65.4 | 10.0 | 1000 | 8.0 | 8.5 | 10.0 | 10.0 |
| Area C | 66.7 | 10.0 | 1175 | 8.5 | 8.5 | 10.0 | 10.0 |
| Area D | 65.3 | 10.0 | 1075 | 8.0 | 8.0 | 10.0 | 10.0 |
| State Avg. 2003 | 65.8 | 10.0 | 1100 | 8.3 | 8.4 | 10.0 | 10.0 |
| State Avg. 2002 | 64.2 | 10.0 | 1135 | 8.3 | 8.6 | 10.0 | 10.0 |
| **NORTH DAKOTA** | | | | | | | |
| Area A | 66.1 | 10.0 | 1110 | 8.5 | 9.0 | 10.0 | 10.0 |
| Area B | 66.1 | 10.0 | 1175 | 8.0 | 8.0 | 10.0 | 10.0 |
| Area C | 65.4 | 10.0 | 1180 | 8.5 | 8.5 | 10.0 | 10.0 |
| Area D | 64.6 | 10.0 | 1100 | 8.5 | 8.0 | 10.0 | 10.0 |
| Area E | 65.0 | 10.0 | 1065 | 8.5 | 8.5 | 10.0 | 10.0 |
| Area F | 61.8 | 10.0 | 1090 | 8.5 | 8.5 | 10.0 | 10.0 |
| State Avg. 2003 | 64.8 | 10.0 | 1120 | 8.4 | 8.4 | 10.0 | 10.0 |
| State Avg. 2002 | 63.2 | 10.0 | 1109 | 8.1 | 8.0 | 10.0 | 10.0 |
| **SOUTH DAKOTA** | | | | | | | |
| Area A | 66.5 | 10.0 | 1140 | 8.5 | 8.5 | 10.0 | 10.0 |
| Area B | 63.0 | 10.0 | 1110 | 8.5 | 8.5 | 10.0 | 10.0 |
| Area C | 60.9 | 10.0 | 1055 | 8.5 | 9.0 | 10.0 | 10.0 |
| State Avg. 2003 | 63.5 | 10.0 | 1102 | 8.5 | 8.7 | 10.0 | 10.0 |
| State Avg. 2002 | 62.7 | 10.0 | 1150 | 8.0 | 8.0 | 10.0 | 10.0 |
| **FOUR-STATE REGION** | | | | | | | |
| Average 2003 | 64.4 | 10.0 | 1092 | 8.4 | 8.4 | 10.0 | 10.0 |
| Average 2002 | 62.9 | 10.0 | 1114 | 8.1 | 8.2 | 10.0 | 10.0 |
| Five-Year Avg. | 62.9 | 9.8 | 1038 | 8.0 | 8.1 | 10.0 | 9.8 |

*All state and regional averages have been adjusted to reflect production differences.*

The 2003 crop has strong mixing properties and high absorption, resulting in excellent bread quality.

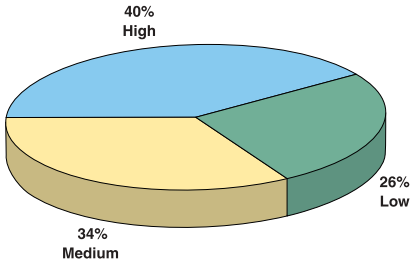
## Average Quality Factors for the Regional Hard Red Spring Wheat Crop

| | 1998 | 1999 | 2000 | 2001 | 2002 | FIVE-YEAR AVERAGE | 2003 |
|---|---|---|---|---|---|---|---|
| **GRADING AND WHEAT DATA** | | | | | | | |
| Test Weight (lbs/bu) | 60.0 | 59.3 | 60.1 | 59.7 | 59.1 | 59.6 | 61.3 |
| Test Weight (kg/hl) | 78.9 | 78.0 | 79.1 | 78.6 | 77.8 | 78.5 | 80.6 |
| Vitreous Kernels (%) | 71 | 63 | 68 | 75 | 71 | 70 | 81 |
| 1000 Kernel Weight (gm) | 31.5 | 31.0 | 31.2 | 29.0 | 28.7 | 30.3 | 30.3 |
| Protein:12% moisture (%) | 14.3 | 14.2 | 14.4 | 14.4 | 15.3 | 14.5 | 14.1 |
| Protein: dry (%) | 16.3 | 16.1 | 16.4 | 16.4 | 17.4 | 16.5 | 16.0 |
| Ash: 14% moisture (%) | 1.68 | 1.65 | 1.67 | 1.71 | 1.68 | 1.68 | 1.60 |
| Falling Number (sec) | 422 | 347 | 343 | 396 | 334 | 368 | 404 |
| **FLOUR DATA** | | | | | | | |
| Flour Extraction (%) | 69.8 | 68.9 | 69.4 | 69.2 | 69.4 | 69.3 | 69.5 |
| Ash: 14% moisture (%) | 0.43 | 0.46 | 0.47 | 0.43 | 0.46 | 0.45 | 0.42 |
| Protein: 14% moisture (%) | 13.0 | 13.0 | 13.2 | 13.3 | 14.1 | 13.3 | 12.9 |
| Wet Gluten (%) | 34.7 | 34.2 | 36.4 | 36.1 | 36.1 | 35.5 | 36.1 |
| Falling Number (sec) | 432 | 368 | 374 | 412 | 375 | 392 | 421 |
| Amylograph Peak Viscosity | | | | | | | |
| 65g FL (B.U.) | 637 | 565 | 549 | 703 | 485 | 588 | 795 |
| 100g FL (B.U.) | 3199 | 2004 | 1947 | 2575 | 1783 | 2302 | 2825 |
| **PHYSICAL DOUGH PROPERTIES:** | | | | | | | |
| Farinograph: | | | | | | | |
| Absorption (%) | 63.6 | 65.7 | 64.9 | 63.2 | 64.4 | 64.4 | 65.9 |
| Peak Time (min) | 14.2 | 11.6 | 9.1 | 10.7 | 14.8 | 12.1 | 11.6 |
| Stability (min) | 19.9 | 18.6 | 15.5 | 17.2 | 24.3 | 19.1 | 21.5 |
| Classification | 6.5 (med strong) | 6.2 (med strong) | 5.6 (med strong) | 6.4 (med strong) | 7.2 (strong) | 6.4 (med strong) | 7.0 (strong) |
| Extensigraph: | | | | | | | |
| Extensibility-45 min (cm) | 21.9 | 22.0 | 22.5 | 23.5 | 24.9 | 23.0 | 23.6 |
| Resistance-45 min (B.U.) | 437 | 420 | 448 | 532 | 538 | 475 | 517 |
| Area-45 min (sq cm) | 122 | 117 | 127 | 154 | 167 | 137 | 153 |
| Alveograph: | | | | | | | |
| P (mm) | 88 | 107 | 86 | 88 | 90 | 92 | 95 |
| L (mm) | 111 | 88 | 122 | 118 | 114 | 111 | 116 |
| W (Joules X $10^{-4}$) | 358 | 354 | 347 | 361 | 380 | 360 | 386 |
| **BAKING DATA:** | | | | | | | |
| Absorption (%) | 62.1 | 64.2 | 63.4 | 61.7 | 62.9 | 62.9 | 64.4 |
| Dough Handling Properties | 9.5 | 10.0 | 9.5 | 10.0 | 10.0 | 9.8 | 10.0 |
| Loaf Volume (cc) | 1000 | 1023 | 1011 | 1044 | 1114 | 1038 | 1092 |
| Grain and Texture | 8.3 | 7.9 | 7.9 | 8.0 | 8.1 | 8.0 | 8.4 |
| Crumb Color | 8.3 | 7.9 | 8.0 | 8.2 | 8.2 | 8.1 | 8.4 |
| Crust Color | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 | 10.0 |
| Symmetry | 9.8 | 9.7 | 9.6 | 10.0 | 10.0 | 9.8 | 10.0 |

## 2003 Regional Quality Factors by Protein Range

| | PROTEIN RANGES | | |
|---|---|---|---|
| | LOW | MEDIUM | HIGH |
| **PRODUCTION %** | 26 | 34 | 40 |
| **WHEAT GRADING DATA** | | | |
| Test Weight (lb/bu) | 62.0 | 61.7 | 59.5 |
| Test Weight (kg/hl) | 81.6 | 81.2 | 78.2 |
| Damage (%) | 0.31 | 0.45 | 0.26 |
| Foreign Material (%) | 0.00 | 0.08 | 0.00 |
| Shrunken/Broken (%) | 1.1 | 0.95 | 1.59 |
| Total Defects (%) | 1.41 | 1.48 | 1.85 |
| Vitreous Kernels (%) | 74 | 78 | 95 |
| Grade | 1NS | 1DNS | 1DNS |
| **WHEAT DATA** | | | |
| Dockage (%) | 1.2 | 1.0 | 0.9 |
| Moisture (%) | 11.9 | 12.1 | 10.8 |
| Protein: 12% moisture (%) | 12.4 | 13.8 | 15.8 |
| Protein: dry basis (%) | 14.1 | 15.7 | 17.9 |
| 1000 Kernel Wt. (gm) | 32.1 | 30.9 | 27.0 |
| Ash: 14% moisture (%) | 1.62 | 1.59 | 1.63 |
| Falling Number (sec) | 410 | 400 | 421 |
| Sedimentation (cc) | 42.4 | 58.0 | 59.9 |
| **FLOUR DATA:** | | | |
| Extraction (%) | 69.9 | 69.8 | 67.4 |
| Protein: 14% moisture (%) | 11.2 | 12.6 | 14.6 |
| Protein: dry basis (%) | 13.0 | 14.6 | 16.9 |
| Ash: 14% moisture (%) | 0.44 | 0.44 | 0.47 |
| Ash: dry basis (%) | 0.51 | 0.51 | 0.55 |
| Wet Gluten (%) | 30.3 | 34.5 | 41.4 |
| Falling Number (sec) | 425 | 419 | 468 |
| Amylograph Viscosity | | | |
| 65g FL (B.U.) | 830 | 791 | 895 |
| 100g FL (B.U.) | 2860 | 2686 | 3098 |
| **DOUGH PROPERTIES:** | | | |
| Farinograph: | | | |
| Peak Time (min) | 8.0 | 13.4 | 21.0 |
| Stability (min) | 23.8 | 25.1 | 29.1 |
| Absorption (%) | 64.2 | 66.4 | 68.2 |
| Valorimeter | 72.6 | 86.3 | 92.8 |
| Classification | 6.6 | 7.3 | 7.7 |
| Alveograph: | | | |
| P (mm) | 103 | 98 | 104 |
| L (mm) | 90 | 121 | 111 |
| W (erg/gm) | 331 | 407 | 426 |
| P/L ratio | 1.20 | 0.82 | 0.95 |
| Extensigraph: | | | |
| Resistance-45 min (BU) | 532 | 513 | 556 |
| Extension-45 min (cm) | 20.2 | 22.2 | 22.5 |
| Area-45 min (sq cm) | 134 | 140 | 156 |
| Resistance-135 min (BU) | 643 | 590 | 643 |
| Extension-135 min (cm) | 18.8 | 21.8 | 22.7 |
| Area-135 min (sq cm) | 148 | 162 | 183 |
| **BAKING EVALUATION:** | | | |
| Absorption (%) | 62.7 | 64.9 | 66.7 |
| Loaf volume (cc) | 957 | 1086 | 1157 |
| Crumb Grain/Texture | 8.0 | 8.4 | 8.5 |

### REGIONAL AVERAGE: PRODUCTION DISTRIBUTION BY PROTEIN RANGE




Performance characteristics often improve as buyers increase their protein specifications. To illustrate the correlation between higher protein and other quality parameters, samples of the regional crop were segregated by protein levels (all based on 12 percent moisture content):

- low (less than 13.5 percent),
- medium (13.5 percent to 14.5 percent), and
- high (more than 14.5 percent).

As protein content increased in the 2003 crop, wet gluten, mixing strength, absorption and loaf volume all improved.

# export cargo sampling

Data contained in previous sections of this report are derived from the testing of samples gathered during harvest from origination points throughout the U.S. hard red spring wheat region. The results provide an assessment of the overall quality of the crop produced in a given year.

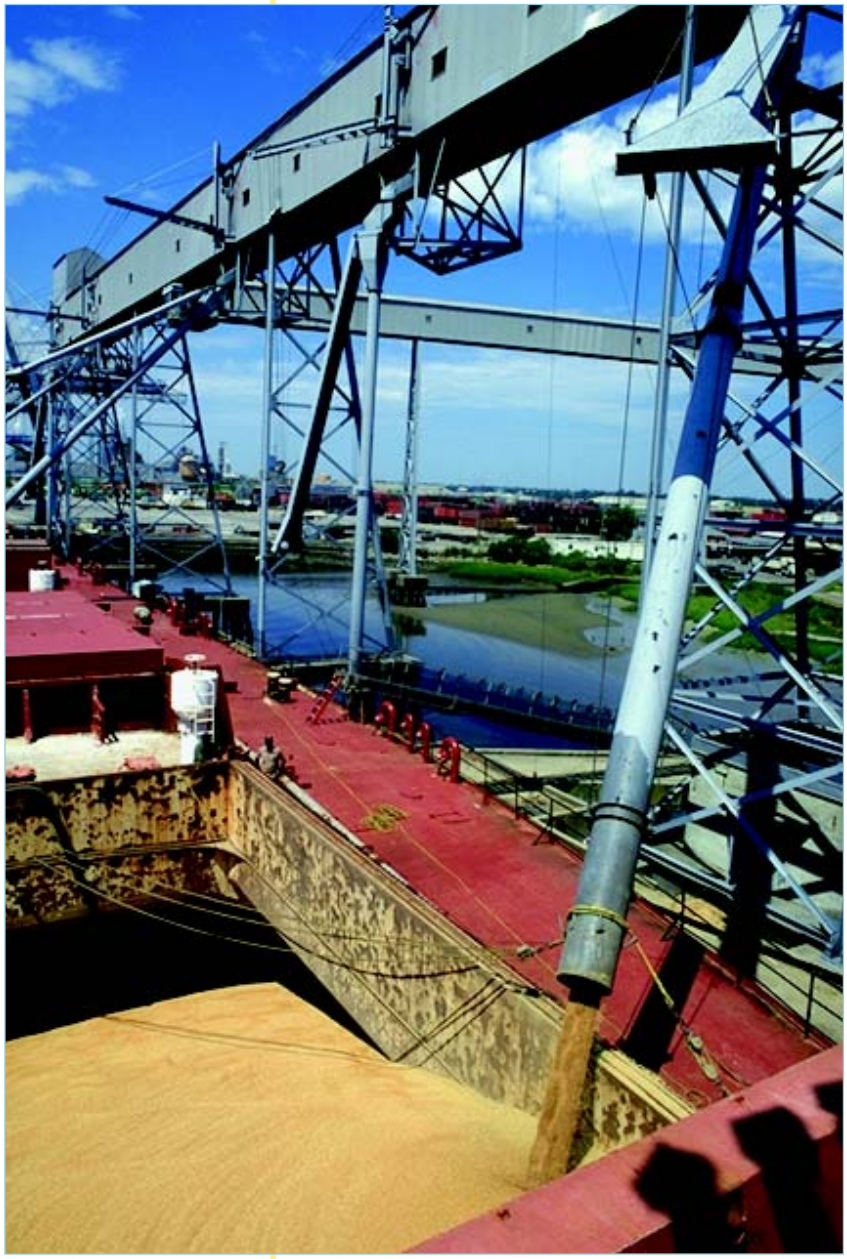


*Photo credit: USDA Agricultural Research Service*

U.S. Wheat Associates, the export market development arm for American wheat growers, furthers this information by commissioning an export cargo sampling program. The program provides an accurate representation of the supplies moving through the grain marketing and transportation system and actually reaching export points. Results show the quality levels at which U.S. wheat is realistically traded and are useful to customers in developing reasonable purchase specifications.

The Federal Grain Inspection Service oversees the program whereby all export inspection agencies at all ports collect every tenth sublot sample from every vessel of U.S. wheat shipped during three two-month time periods annually.

The hard red spring wheat samples are sent to the North Dakota State University Cereal Science Department for analysis. Average results for the past two years are at right.

# Export Cargo Data

| | PNW AVERAGE | | GREAT LAKES AVERAGE | | GULF AVERAGE | |
|---|---|---|---|---|---|---|
| | 2001 | 2002* | 2001 | 2002* | 2001 | 2002* |
| **SAMPLE COUNT** | 117 | 108 | 79 | 36 | 62 | 30 |
| **GRADING DATA** | | | | | | |
| Test Weight (lbs/bu) | 61.5 | 60.8 | 60.2 | 60.0 | 60.5 | 60.0 |
| Test Weight (kg/hl) | 80.9 | 79.9 | 79.2 | 78.9 | 79.6 | 79.0 |
| Damaged Kernels (%) | 0.5 | 0.5 | 1.5 | 1.5 | 1.4 | 1.3 |
| Foreign Material (%) | 0.2 | 0.1 | 0.1 | 0.2 | 0.2 | 0.2 |
| Shrunken & Broken (%) | 1.8 | 1.6 | 1.6 | 1.4 | 1.5 | 1.5 |
| Total Defects (%) | 2.4 | 2.3 | 3.3 | 3.0 | 3.1 | 3.0 |
| Vitreous Kernels (%) | 83.2 | 74.6 | 53.8 | 47.6 | 60.8 | 60.3 |
| Grade | 1DNS | 1NS | 2NS | 2NS | 2NS | 2NS |
| **OTHER WHEAT DATA** | | | | | | |
| Dockage (%) | 0.4 | 0.3 | 0.5 | 0.5 | 0.7 | 0.7 |
| Moisture (%) | 10.7 | 11.6 | 12.3 | 12.9 | 12.2 | 12.7 |
| Protein: 12% Moisture (%) | 14.3 | 14.4 | 14.5 | 14.6 | 14.2 | 14.6 |
| Protein: Dry (%) | 16.2 | 16.3 | 16.5 | 16.6 | 16.2 | 16.6 |
| Ash: 14% Moisture (%) | 1.63 | 1.57 | 1.99 | 1.98 | 1.69 | 1.69 |
| Ash: Dry (%) | 1.90 | 1.83 | 1.71 | 1.70 | 1.96 | 1.97 |
| 1000 Kernel Weight (g) | 30.4 | 32.8 | 28.9 | 29.5 | 29.3 | 30.0 |
| Kernel Size (%) lg/md/sm | 53/39/8 | 55/37/8 | 49/42/9 | 48/41/11 | 51/41/9 | 48/42/10 |
| Single Kernel: Hardness | 78.5 | 74.6 | 76.5 | 76.6 | 75.6 | 75.6 |
| Weight (mg.) | 31.2 | 32.2 | 29.1 | 28.6 | 29.5 | 28.6 |
| Diameter (mm) | 2.40 | 2.42 | 2.31 | 2.29 | 2.31 | 2.27 |
| Falling Number (sec) | 403 | 407 | 352 | 342 | 375 | 345 |
| **FLOUR DATA** | | | | | | |
| Flour Extraction (%) | 70.3 | 70.2 | 70.6 | 70.3 | 70.7 | 70.0 |
| Color: L (white-black) | 90.4 | 89.4 | 90.2 | 88.6 | 90.4 | 89.0 |
| a (red-green) | -1.4 | -1.3 | -1.4 | -1.3 | -1.4 | -1.3 |
| b (yellow-blue) | 8.7 | 8.4 | 9.1 | 9.2 | 9.0 | 9.0 |
| Protein: 14% Moisture (%) | 13.2 | 13.3 | 13.2 | 13.4 | 13.0 | 13.5 |
| Protein: Dry (%) | 15.3 | 15.5 | 15.4 | 15.6 | 15.1 | 15.6 |
| Ash: 14% Moisture (%) | 0.48 | 0.46 | 0.49 | 0.47 | 0.49 | 0.47 |
| Ash: Dry (%) | 0.56 | 0.53 | 0.57 | 0.55 | 0.57 | 0.54 |
| Wet Gluten (%) | 36.3 | 35.6 | 36.2 | 35.1 | 35.4 | 35.2 |
| Falling Number (sec) | 444 | 461 | 387 | 380 | 413 | 392 |
| Amylograph Peak Viscosity | | | | | | |
| 65g FL (B.U.) | 591 | 627 | 455 | 432 | 535 | 448 |
| **PHYSICAL DOUGH DATA:** | | | | | | |
| Farinograph: | | | | | | |
| Absorption (%) | 65.1 | 66.8 | 63.7 | 64.8 | 63.2 | 64.5 |
| Peak Time (min) | 8.7 | 11.4 | 7.6 | 9.3 | 7.8 | 9.5 |
| Stability (min) | 18.1 | 24.2 | 13.1 | 16.8 | 14.5 | 18.0 |
| Classification | 6.5 | 7.3 | 5.6 | 6.6 | 5.9 | 6.8 |
| Alveograph: | | | | | | |
| P (mm) | 103 | 117 | 89 | 100 | 90 | 100 |
| L (mm) | 105 | 99 | 108 | 108 | 110 | 109 |
| W (Joules X $10^{-4}$) | 376 | 413 | 336 | 368 | 344 | 395 |
| **BAKING DATA:** | | | | | | |
| Absorption (%) | 63.6 | 65.3 | 62.2 | 63.3 | 61.7 | 63.0 |
| Loaf Volume (cc) | 1035 | 1023 | 1044 | 1075 | 1040 | 1056 |
| Crumb Grain and Texture | 8.2 | 8.2 | 8.1 | 8.4 | 8.2 | 8.1 |

** Preliminary results based on testing of approximately two-thirds of expected samples.*

# laboratory analysis

All quality data contained in this report are the result of testing and analysis conducted by or under the supervision of T.C. Olson, R. Olson, K. McMonagle, and W. Robinson, food technologists with the Department of Cereal Science at North Dakota State University, Fargo, USA.

The Cereal Science Department was established in 1905 for the primary purpose of evaluating the quality of hard red spring wheat cultivars grown in North Dakota. Today, the Cereal Science Department works to improve and promote the quality and use of cereal grains and other U.S. northern grown crops through graduate training, basic and applied research, and service.

COLLECTION The North Dakota, South Dakota, Montana and Minnesota state offices of the National Agricultural Statistics Service obtained wheat samples during harvest directly from growers, farm bins and local elevators. These samples reflect the condition of the grain at the point of origin. Collection began in mid-July in South Dakota when approximately 10 percent of the hard red spring wheat had been harvested and continued until early September when more than 95 percent of the region's crop was harvested.

Sample collection was weighted by county production histories with a total of 849 samples being collected during harvest from Minnesota (121), Montana (207), North Dakota (395), and South Dakota (126).

*Photo credit: North Dakota Mill*

ANALYSIS Approximately 40 percent of the total wheat samples collected were analyzed for grade and other physical kernel characteristics. Distributions as a percentage of the harvested crop were calculated for key factors including test weight, thousand kernel weight, protein, falling number, and overall grade. Distribution results may differ from data presented in the various tables, because the latter are derived from production adjusted averages, rather than simple averages.

Quality tests, including milling, flour evaluation, physical dough and bread properties, were conducted on composite samples representing each crop reporting area. Again, all state and regional averages have been adjusted to reflect production as opposed to simple averaging.

## WHEAT

SAMPLE COLLECTION Each sample contained approximately 2 to 3 pounds of wheat, stored in securely closed, moisture proof plastic bags.

MOISTURE Official USDA procedure using Motomco Moisture Meter.

GRADE Official United States Standards for Grain, as determined by a licensed grain inspector. North Dakota Grain Inspection Service, Fargo, ND, provided grades for composite wheat samples representing each crop reporting area.

VITREOUS KERNELS Approximate percentage of kernels having vitreous endosperm.

DOCKAGE Official USDA procedure. All matter other than wheat which can be removed readily from a test portion of the original sample by use of an approved device (Carter Dockage Tester). Dockage may also include underdeveloped, shriveled and small pieces of wheat kernels removed in properly separating the material other than wheat and which cannot be recovered by properly rescreening or recleaning.

TEST WEIGHT American Association of Cereal Chemists Method 55-10 approved April 1961, revised October 1999. Measured as pounds per bushel (lb/bu), Kilograms per hectoliter (Kg/hl) = (lbs/bu X 1.292) + 1.419. *Approved Methods of the American Association of Cereal Chemists, Cereal Laboratory Methods (10th Edition), St. Paul, MN (2000).

THOUSAND KERNEL WEIGHT Based on 10 gram sample of cleaned wheat (free of foreign material and broken kernels) counted by electronic seed counter.

KERNEL SIZE DISTRIBUTION Percentages of the size of kernels (large, medium, small) were determined using a wheat sizer equipped with the following sieve openings:

- top sieve—Tyler #7 with 2.92 mm opening;
- middle sieve—Tyler #9 with 2.24 mm opening; and
- bottom sieve—Tyler #12 with 1.65 mm opening.

PROTEIN American Association of Cereal Chemists (AAC) Method: 46-30 (Combustion Method), expressed on dry basis and 12 percent moisture basis.

ASH American Association of Cereal Chemists Method 08-01, approved April 1961, revised October 1999; expressed on a 14 percent moisture basis.

FALLING NUMBER American Association of Cereal Chemists Method 56-81B, approved November 1972, revised September 1999; units of seconds (14 percent moisture basis).

SEDIMENTATION American Association of Cereal Chemists Method 56-61A, expressed in centimeters. Approved Methods of the American Association of Cereal Chemists, (8th Edition), St. Paul, MN (1983).

## FLOUR

EXTRACTION Thoroughly cleaned wheat is tempered to 15.5 percent moisture for 16 hours and an additional 0.5 percent water is added five minutes prior to milling. The milling laboratory is controlled at 68 percent relative humidity and 72°F to 74°F. Milling is performed on a Buhler laboratory mill (Type MLU-202). Straight grade flour (of all six flour streams) is blended and reported as "flour extraction." The blended flour is rebolted through an 84 SS sieve to remove any foreign material. This product is used for the other flour quality determinations.

Photo credit: USDA Agricultural Research Service

ASH American Association of Cereal Chemists Method 08-01, approved April 1961, revised October 1999; expressed on a 14 percent moisture basis.

PROTEIN American Association of Cereal Chemists (AACC) Method 46-30 (Combustion Method), expressed on a 14 percent moisture basis.

WET GLUTEN American Association of Cereal Chemists Method 38-12, approved October 1999; expressed on a 14 percent moisture basis determined with the glutomatic instrument.

FLOUR FALLING NUMBER American Association of Cereal Chemists Method 56-81B, approved November 1972, revised September 1992; units of seconds. Determination is performed on 7.0 g of Buhler milled flour (14 percent moisture basis).

AMYLOGRAM (100 g) American Association of Cereal Chemists Method 22-10. Peak viscosity reported in Brabender units (B.U.), on a 14 percent moisture basis.

(65 g) American Association of Cereal Chemists Method 22-10, modified as follows: 65 g of flour (14 percent moisture basis) are slurried in 450 ml distilled water, paddle stirrers are used with the Brabender Amylograph. Peak viscosity reported in Brabender units (B.U.), on a 14 percent moisture basis.

## PHYSICAL DOUGH PROPERTIES

FARINOGRAM American Association of Cereal Chemists Method 54-21; constant flour weight method, small (50 g) mixing bowl. (Flour weight 14 percent moisture basis)

Absorption Amount of water required to center curve peak on the 500 Brabender unit line, expressed on a 14 percent moisture basis.

Peak Time The time interval, to the nearest 0.5 min, from the first addition of water to the maximum consistency immediately prior to the first indication of weakening. Also referred to as dough development time.

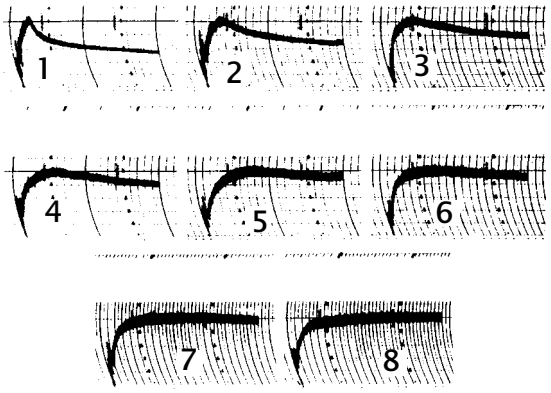
Stability The time interval, to the nearest 0.5 min, between the point where the top of the curve that first intersects the 500-BU line and the point where the top of the curve departs the 500-BU line.

Mixing Tolerance Index The difference, in Brabender units, from the top of the curve at the peak to the top of the curve measured five minutes after the peak.

Valorimeter Value An empirical, single-figure quality score based on the development time and tolerance to mixing. Derived from the farinogram by means of a special template supplied by the equipment manufacturer. Generally, stronger flours have higher valorimeter values.

Classification An empirical classification incorporating peak time, stability, MTI, and general curve characteristics. A scale of 1 to 8 is employed with higher values indicating stronger curve types.

REFERENCE FARINOGRAMS
FOR HARD RED SPRING WHEAT



EXTENSIGRAM American Association of Cereal Chemists Method 54-10, approved April 1961, revised October 1982; modified as follows: (a) one hundred grams of flour (14 percent moisture basis), 2.0 percent sodium chloride (U.S.P.) and water (equal to farinograph absorption minus 2 percent) are mixed to optimum development in a National pin dough mixer; (b) doughs are scaled to 150 grams, rounded, moulded, placed in extensigram holders, and rested for 45 minutes and 135 minutes, respectively, at 30°C and 78 percent relative humidity. The dough is then stretched as described in the procedure referenced above. For conversion purposes, 500 grams equals 400 B.U.

Extensibility Total length of the curve at the base line in centimeters.

Resistance Maximum curve height, reported in Brabender units (B.U.).

Area The area under the curve is measured and reported in square centimeters.

ALVEOGRAPH International Association of Cereal Chemists Standard No. 121. Measurement of dough extensibility and resistance to extension.

"P" Maximal overpressure; related to dough's resistance to deformation.

"L" Dough extensibility.

"W" The "work" associated with dough deformation.

## BAKING

PROCEDURE American Association of Cereal Chemists Method 10-09, approved September 1985; modified as follows: (a) fungal amylase (SKB 15) replacing malt dry powder, (b) Instant dry yeast (1 percent) in lieu of compressed yeast, (c) 5 to 10 ppm bromate, where added oxidants are required, (d) 2 percent shortening added. Doughs are mechanically punched using 6-inch rolls, and mechanically moulded using a National "Roll-R-Up" moulder. Baking is accomplished in "Shogren-type" pans.

BAKING ABSORPTION Water amount required for optimum dough baking performance, expressed as a percent of flour weight on a 14 percent moisture basis.

DOUGH CHARACTER Dough handling characteristics assessed at panning on a scale of 1 to 10, the higher scores preferred.

LOAF VOLUME Rapeseed displacement measurement made 30 minutes after bread is removed from the oven.

CRUMB GRAIN AND TEXTURE Visual comparison to standard using a constant illumination source. Scale of 1 to 10, the higher scores preferred.

CRUMB COLOR Visual comparison with a standard using a constant illumination source on a scale of 1 to 10, the higher scores preferred.

*Photo credit:*
*NDSU Cereal Science Department*

CRUST COLOR Visual comparison with a standard using a constant illumination source on a scale of 1 to 10, the higher scores preferred.

SYMMETRY Visual comparison with a standard using a constant illumination source on a scale of 1 to 10, the higher scores preferred.

# varietal information

Quality products begin with quality ingredients. In wheat, quality begins with the varieties planted. Within the hard red spring class of wheat, there are different varieties available — all with relatively uniform characteristics. Spring wheat variety development is carried out at experiment stations at North Dakota State University in Fargo, the University of Minnesota in St. Paul, South Dakota State University in Brookings, and Montana State University in Bozeman. Public plant breeders at these experiment stations develop and release most of the hard red spring wheat varieties available in the United States, although more private firms are developing spring wheat breeding programs.

## Popular and New Hard Red Spring Wheat Varieties

**GROWN & TESTED IN NORTH DAKOTA**

| VARIETY | AGENT[1] OR ORIGIN | YEAR RELEASED | AGRONOMIC DESCRIPTION HEIGHT | STRAW STRENGTH | MATURITY | REACTION TO DISEASE[2] LEAF RUST | FOLIAR DISEASE | HEAD (SCAB) | AVERAG EASTERN[3] NORTH DAKOTA BU/ACRE | MT/HA |
|---|---|---|---|---|---|---|---|---|---|---|
| Alsen | ND | 2000 | s.dwf. | strg. | m.early | MR | S | MR | 42.5 | 2.86 |
| Briggs | SD | 2002 | s.dwf. | strg | m.early | R | MS | MS | 53.3 | 3.58 |
| Gunner | AgriPro | 1995 | med. | m.strg. | med. | S | M | M | 37.4 | 2.51 |
| Ingot | SD | 1998 | s.dwf. | med. | early | S | S | MS* | 40.0 | 2.69 |
| Knudson | AgriPro | 2001 | s.dwf. | strg | med. | MR | S | M | 45.6 | 3.07 |
| Mercury | N Star G | 1999 | s.dwf. | strg | m.early | MS | S | S | 46.9 | 3.15 |
| Norpro | AgriPro | 1999 | s.dwf. | strg | med. | MS | S | MS | 46.0 | 3.09 |
| Oxen | SD | 1996 | s.dwf. | strg. | m.early | S | S | S | 47.5 | 3.19 |
| Parshall | ND | 1999 | med. | strg. | m.early | MS | M | M | 45.2 | 3.04 |
| Reeder | ND | 1999 | s.dwf. | strg. | m.early | MS | M | S | 45.9 | 3.09 |
| Russ | SD | 1995 | med. | med. | m.early | S | S | S* | 47.8 | 3.21 |
| Walworth | SD | 2001 | s.dwf. | med. | m.early | S | S | S | 46.3 | 3.11 |

**GROWN & TESTED IN MONTANA**

| VARIETY | AGENT[1] OR ORIGIN | YEAR RELEASED | AGRONOMIC DESCRIPTION HEIGHT | STRAW STRENGTH | MATURITY | REACTION TO DISEASE[2] LEAF RUST | FOLIAR DISEASE | HEAD (SCAB) | AVERAGE YIELD[7] STATEWIDE BU/ACRE | MT/HA |
|---|---|---|---|---|---|---|---|---|---|---|
| Amidon | ND | 1988 | tall | med. | med. | R | NA | S | 63.5 | 4.27 |
| Ernest | ND | 1995 | tall | med. | med. | R | NA | S | 62.3 | 4.19 |
| Fortuna | ND-MT | 1966 | tall | weak | med. | R | NA | S | 55.6 | 3.74 |
| McNeal | MT | 1995 | s.dwf. | strg. | m.late | MS | NA | S | 66.3 | 4.46 |
| Reeder | ND | 1999 | s.dwf. | strg. | m.early | MR | NA | S | 68.3 | 4.59 |

*1 ND=North Dakota State University (Public), SD=South Dakota State University (Public), AgriPro (Private), NStarG=North Star Genetics (Private).*

*2 Reaction to Disease: resistant (R), moderately resistant (MR), intermediate (M), moderately susceptible (MS), susceptible (S), very susceptible (VS). *Indicates yield and/or quality have often been higher than would be expected based on visual head blight symptoms alone.*

*3 2002 North Dakota yield data from Fargo, Carrington and Langdon research test plots.*

*4 2002 North Dakota yield data from Minot, Williston, Dickinson and Hettinger research test plots.*

Quality evaluation equipment and methods differ between laboratories. Comparisons should only be made among varieties tested in the same laboratory, not between laboratories.

Before any spring wheat variety is released to the public, it must meet or exceed current standards for the class. Prospective variety releases are evaluated for milling and baking characteristics as well as for yield, protein content, test weight, resistance to diseases and insects, and straw strength.

*Photo credit:*
*USDA Agricultural Research Service*

| GE YIELD | | QUALITY FACTORS[5] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| WESTERN[4] NORTH DAKOTA BU/ACRE | MT/HA | TEST WEIGHT LB/BU | TEST WEIGHT KG/HL | WHEAT[6] PROTEIN % | WHEAT FALLING # SEC | FLOUR EXTRACTION % | FARINOGRAM CLASS (1–8) | BAKE ABSORPTION % | LOAF VOLUME CC | VARIETY |
| 42.2 | 2.84 | 59.7 | 78.6 | 16.5 | 382 | 69.6 | 7.0 | 67.2 | 1167 | Alsen |
| 42.2 | 2.84 | 58.8 | 77.4 | 16.2 | 438 | 69.8 | 6.2 | 66.2 | 1061 | Briggs |
| 38.3 | 2.57 | 59.0 | 77.6 | 16.7 | 415 | 69.9 | 6.5 | 68.1 | 1097 | Gunner |
| 40.8 | 2.74 | 60.3 | 79.3 | 15.8 | 359 | 70.6 | 6.3 | 64.9 | 1172 | Ingot |
| 41.3 | 2.78 | 59.0 | 77.6 | 15.6 | 372 | 69.7 | 7.2 | 66.5 | 1081 | Knudson |
| 43.2 | 2.90 | 58.1 | 76.5 | 15.6 | 356 | 70.7 | 6.8 | 65.5 | 1119 | Mercury |
| 44.3 | 2.98 | 58.3 | 76.7 | 15.9 | 371 | 67.8 | 6.2 | 67.5 | 1112 | Norpro |
| 44.0 | 2.96 | 56.8 | 74.8 | 15.7 | 380 | 70.2 | 7.3 | 64.5 | 1150 | Oxen |
| 42.8 | 2.88 | 59.7 | 78.6 | 16.2 | 388 | 69.2 | 6.8 | 65.4 | 1208 | Parshall |
| 45.4 | 3.05 | 58.9 | 77.5 | 15.9 | 380 | 68.4 | 6.0 | 64.9 | 1124 | Reeder |
| 39.5 | 2.66 | 57.2 | 75.3 | 15.5 | 385 | 69.8 | 6.8 | 65.6 | 1133 | Russ |
| 40.4 | 2.72 | 57.3 | 75.5 | 16.0 | 383 | 69.8 | 7.7 | 63.3 | 1202 | Walworth |

| QUALITY FACTORS[8] | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| TEST WEIGHT LB/BU | TEST WEIGHT KG/HL | WHEAT[6] PROTEIN % | WHEAT FALLING # SEC | FLOUR EXTRACTION % | MIXOGRAPH[9] TOLERANCE (1–5) | MIXOGRAPH ABSORPTION % | LOAF VOLUME CC | VARIETY |
| 59.8 | 78.7 | 15.1 | NA | 68.0 | 3.3 | 64.7 | 1092 | Amidon |
| 60.6 | 79.7 | 15.9 | NA | 67.7 | 3.3 | 65.2 | 1185 | Ernest |
| 60.1 | 79.1 | 15.3 | NA | 67.9 | 2.5 | 63.4 | 1095 | Fortuna |
| 59.6 | 78.4 | 15.1 | NA | 64.4 | 5.0 | 64.5 | 1191 | McNeal |
| 60.6 | 79.7 | 15.6 | NA | 65.2 | 2.8 | 63.8 | 1101 | Reeder |

*5 Source: NDSU Cereal Science Department. Data from 2002 field plot trials in 6 locations.*

*6 Wheat protein content is expressed on a 12 percent moisture basis.*

*7 2000–02 yield data based on samples grown in the advanced spring wheat nurseries in Montana (28 locations).*

*8 Source: Montana State University Plant Sciences and Plant Pathology Department. Data from 2000–2002 advanced nursery trials (11 location average).*

*9 Mixogram tolerance on scale of 1 to 5 where 1 is weak and 5 is very strong.*

## NORTH DAKOTA

The North Dakota Agricultural Statistics Service reports that leading varieties in 2003 are Alsen, Gunner, Reeder, Parshall, and Oxen. Of the 6.4 million acres of spring wheat planted in North Dakota, the top five varieties account for 71 percent.

ALSEN is again the leading variety in North Dakota with 37 percent of the acres and second in Minnesota with 17 percent of acres. It is especially dominant in northern areas. Alsen is moderately resistant to fusarium headblight, has a competitive yield and good milling and baking quality.

REEDER is the second ranked variety in both North Dakota and Montana with 12 and 17 percent of the acres, respectively. It is primarily planted from northeast Montana to southwest North Dakota. Reeder is among the highest yielding varieties for western production zones and is rated average for milling and baking quality.

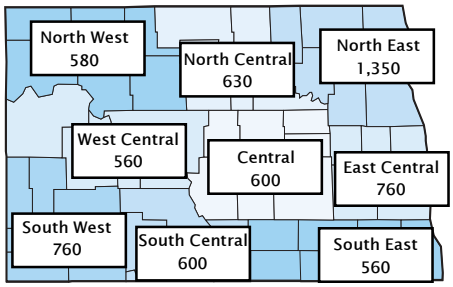
PARSHALL appeals to all districts of North Dakota as well as Minnesota. It is competitive in yield and has intermediate resistance to fusarium headblight. Parshall has good milling and baking qualities and is the quality standard in regional breeding programs.

### Spring Wheat Varieties
### Planted Acres in North Dakota

| VARIETY | 2002 %[1] | 2003 %[1] | 2003 ACRES[3] (1,000) |
|---|---|---|---|
| Alsen | 30.8 | 37.4 | 2,390.5 |
| Reeder | 8.6 | 12.4 | 791.3 |
| Parshall | 7.9 | 9.4 | 600.0 |
| Oxen | 7.6 | 5.9 | 380.5 |
| Norpro | 3.1 | 5.4 | 343.8 |
| Russ | 6.0 | 3.7 | 239.7 |
| Gunner | 9.1 | 3.0 | 191.1 |
| Ingot | 6.7 | 2.6 | 167.6 |
| Walworth | 0.5 | 2.0 | 127.3 |
| 2375 | 3.4 | 1.8 | 114.9 |
| Grandin | 1.6 | 1.8 | 114.2 |
| Briggs | 0.0 | 1.5 | 93.5 |
| Mercury | 0.6 | 1.1 | 72.1 |
| Knudson | 0.1 | 1.0 | 64.3 |
| Butte 86 | 1.1 | 1.0 | 61.3 |
| Other[2] | 12.9 | 10.1 | 647.9 |

1/Percentages may not add to 100 due to rounding. 2/Includes varieties with less than 1% of acreage in 2003 and unknown varieties. 3/Based on June survey. USDA's Sept. report estimates final planted acres at 6.5 million.

NORTH DAKOTA
AGRICULTURAL STATISTICS DISTRICTS
PLANTED AREA (1,000 ACRES)

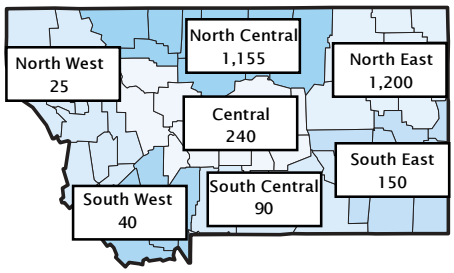



### Spring Wheat Varieties in North Dakota
### Share of 2003 Seeded Acres by Crop District

| VARIETY | NORTH WEST | NORTH CENTRAL | NORTH EAST | WEST CENTRAL | CENTRAL | EAST CENTRAL | SOUTH WEST | SOUTH CENTRAL | SOUTH EAST | STATE |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | PERCENTAGE (%)[1] | | | | | |
| Alsen | 56.6 | 67.7 | 57.7 | 24.9 | 46.2 | 30.0 | 8.4 | 10.0 | 15.9 | 37.4 |
| Reeder | 7.2 | 5.0 | 2.2 | 18.3 | 8.3 | 0.4 | 47.8 | 20.8 | 8.1 | 12.4 |
| Parshall | 9.1 | 5.5 | 12.2 | 9.9 | 11.6 | 8.7 | 11.1 | 6.8 | 5.8 | 9.4 |
| Oxen | 0.0 | 0.0 | 0.7 | 4.8 | 0.2 | 16.4 | 3.2 | 7.5 | 26.6 | 5.9 |
| Norpro | 0.3 | 4.2 | 5.8 | 6.7 | 10.0 | 6.5 | 3.8 | 5.7 | 4.8 | 5.4 |
| Russ | 4.0 | 1.8 | 1.4 | 1.6 | 8.7 | 1.2 | 2.6 | 8.7 | 7.8 | 3.7 |
| Gunner | 7.9 | 6.4 | 1.5 | 7.6 | 0.9 | 0.0 | 2.0 | 3.4 | 0.3 | 3.0 |
| Ingot | 0.0 | 0.0 | 0.6 | 0.7 | 0.7 | 9.8 | 0.0 | 0.8 | 12.9 | 2.6 |
| Walworth | 0.0 | 0.0 | 0.8 | 0.0 | 0.6 | 9.7 | 0.0 | 0.2 | 6.7 | 2.0 |
| 2375 | 0.0 | 1.6 | 1.3 | 0.4 | 0.4 | 3.9 | 1.2 | 6.7 | 0.6 | 1.8 |
| Grandin | 1.6 | 0.0 | 0.3 | 4.3 | 0.3 | 0.0 | 4.5 | 6.2 | 0.7 | 1.8 |
| Briggs | 0.1 | 0.3 | 2.6 | 0.0 | 1.9 | 4.4 | 0.0 | 0.1 | 2.0 | 1.5 |
| Mercury | 0.0 | 0.0 | 3.6 | 0.0 | 0.0 | 0.8 | 0.0 | 1.7 | 1.3 | 1.1 |
| Knudson | 0.9 | 2.5 | 1.4 | 0.3 | 1.8 | 1.3 | 0.0 | 0.0 | 0.2 | 1.0 |
| Butte 86 | 0.0 | 0.0 | 0.0 | 0.7 | 1.7 | 0.2 | 1.8 | 4.3 | 1.1 | 1.0 |
| Other[2] | 12.3 | 4.9 | 7.8 | 19.7 | 6.7 | 10.1 | 13.7 | 17.5 | 5.2 | 10.1 |
| | | | | | 1,000 ACRES[3] | | | | | |
| All Varieties | 580 | 630 | 1,350 | 560 | 600 | 760 | 760 | 600 | 560 | 6,400 |

1/Columns may not add to 100 due to rounding. 2/Includes varieties with less than 1% of acreage in 2003 and unknown varieties. 3/Based on June survey. USDA's Sept. report estimates final planted acres at 6.5 million.

MONTANA AGRICULTURAL STATISTICS DISTRICTS
2003 PLANTED AREA (1,000 ACRES)




## Spring Wheat Varieties Planted Acres in Montana

| VARIETY | 2002 %[1] | 2003 %[1] | 2003 ACRES (1,000) |
|---|---|---|---|
| McNeal | 38.8 | 36.1 | 1,047.9 |
| Reeder | 9.1 | 17.4 | 503.6 |
| Ernest | 11.4 | 11.2 | 324.6 |
| Amidon | 6.2 | 4.0 | 115.6 |
| Fortuna | 7.8 | 3.9 | 114.2 |
| Conan | 5.0 | 3.8 | 109.3 |
| Scholar | 1.9 | 3.0 | 87.2 |
| Lew | 1.8 | 2.9 | 82.9 |
| Westbred Rambo | 3.8 | 2.8 | 80.9 |
| Parshall | 1.4 | 1.6 | 46.0 |
| Westbred 926 | 1.5 | 1.2 | 34.7 |
| Hank | 0.3 | 1.2 | 34.7 |
| Westbred 936 | 1.1 | 1.1 | 31.8 |
| Grandin | 1.3 | 1.1 | 30.7 |
| Other[2] | 8.6 | 8.9 | 255.9 |

1/Percentages may not add to 100 due to rounding. 2/Includes varieties with less than 1% of acreage in 2003 and unknown varieties.

## Spring Wheat Varieties in Montana Share of 2003 Seeded Acres by Crop District

| VARIETY | NORTH WEST | NORTH CENTRAL | NORTH EAST | CENTRAL | SOUTH WEST | SOUTH CENTRAL | SOUTH EAST | TOTAL STATE |
|---|---|---|---|---|---|---|---|---|
| | | | | PERCENTAGE (%)[1] | | | | |
| McNeal | 21.8 | 27.4 | 40.9 | 51.0 | 44.3 | 57.5 | 28.8 | 36.1 |
| Reeder | 0.1 | 1.2 | 37.4 | 6.8 | 10.0 | 5.9 | 10.2 | 17.4 |
| Ernest | 0.0 | 21.4 | 3.5 | 11.3 | 0.0 | 0.9 | 5.0 | 11.2 |
| Amidon | 0.0 | 3.1 | 5.5 | 0.5 | 0.0 | 7.7 | 3.8 | 4.0 |
| Fortuna | 1.0 | 8.4 | 0.6 | 2.2 | 0.0 | 4.9 | 0.0 | 3.9 |
| Conan | 0.0 | 9.1 | 0.2 | 0.3 | 0.0 | 0.0 | 0.7 | 3.8 |
| Scholar | 0.0 | 5.8 | 1.0 | 2.6 | 0.0 | 0.0 | 1.3 | 3.0 |
| Lew | 0.0 | 6.3 | 0.5 | 0.0 | 0.0 | 4.2 | 0.2 | 2.9 |
| Westbred Rambo | 0.0 | 5.7 | 0.3 | 3.1 | 0.5 | 4.3 | 0.0 | 2.8 |
| Parshall | 0.0 | 0.0 | 2.3 | 0.0 | 0.0 | 1.5 | 11.3 | 1.6 |
| Westbred 926 | 28.2 | 0.3 | 0.0 | 6.9 | 2.9 | 5.4 | 0.9 | 1.2 |
| Hank | 16.3 | 2.2 | 0.0 | 1.8 | 0.5 | 0.8 | 0.0 | 1.2 |
| Westbred 936 | 10.2 | 0.8 | 0.0 | 3.2 | 30.7 | 0.0 | 0.0 | 1.1 |
| Grandin | 0.0 | 0.0 | 1.1 | 0.0 | 0.0 | 1.6 | 10.7 | 1.1 |
| Other & Unknown[2] | 21.6 | 8.3 | 6.7 | 10.3 | 11.2 | 5.3 | 26.9 | 8.9 |
| | | | | 1,000 ACRES | | | | |
| All Varieties | 25 | 1,155 | 1,200 | 240 | 40 | 90 | 150 | 2,900 |

1/Columns may not add to 100 due to rounding. 2/Includes varieties with less than 1% of acreage in 2003 and unknown varieties.

## MONTANA

A survey conducted by USDA's Montana Agricultural Statistics Service reveals that the most popular varieties of hard red spring wheat planted in the state in 2003 are McNeal, Reeder, Ernest, Amidon and Fortuna. Of the 2.9 million acres planted, the top five varieties account for 73 percent.

MCNEAL remains the top variety with 36 percent of acres and broad appeal statewide. McNeal is a medium height variety that has moderate resistance to wheat streak mosaic virus. It has average test weight, slightly less than average protein, but uniquely strong dough characteristics.

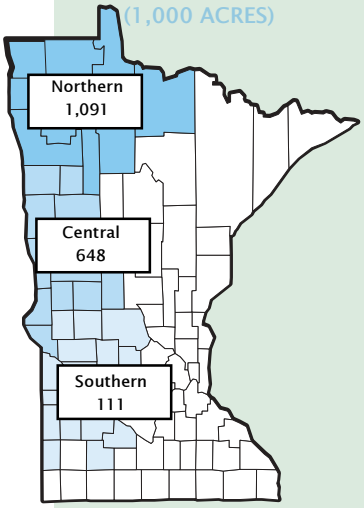
REEDER nearly doubled its acres from 2002 in Montana and is close to overtaking McNeal as the top variety in the northeast. Reeder has high test weight and average protein, but tends to have weaker dough characteristics than traditional hard red spring wheats.

ERNEST declined from second to third, but its share of the acres remained stable at 11 percent. It is most popular in central districts because it is a solid stem variety resistant to wheat stem sawfly. Ernest has high test weight and protein.

## MINNESOTA & SOUTH DAKOTA

An unofficial survey conducted by the Minnesota Wheat Research and Promotion Council indicates the most popular varieties of hard red spring wheat planted in Minnesota in 2003 are Oxen, Alsen, Reeder, Parshall and Walworth. The most recent survey conducted by the South Dakota Agricultural Statistics Service, from 2002, found Oxen to be the most popular variety, followed by Russ, Forge, Ingot and Walworth.

MINNESOTA
2003 PLANTED AREA
(1,000 ACRES)

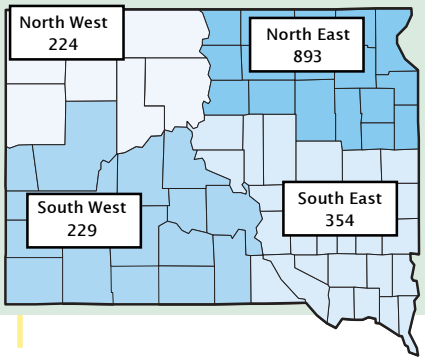



OXEN is the top variety in both Minnesota and South Dakota with nearly a fourth of the acres. It is also the fourth ranked variety in North Dakota with 6 percent of acres. Its primary area of production is from central Minnesota to northeast South Dakota. Its yield and early- to mid-season maturity drive its popularity. Oxen has average protein and test weight, with relatively strong dough mixing properties.

RUSS is the second most popular variety in South Dakota with 18 percent of acres. Its acreage has declined in recent years, but it continues to find popularity in northwest South Dakota.

FORGE is the third most popular variety in South Dakota with 17 percent of acres. It is the leading variety in the southeast where its very early maturity is a plus.

SOUTH DAKOTA AGRICULTURAL
STATISTICS DISTRICTS
2002 PLANTED AREA (1,000 ACRES)




## Spring Wheat Varieties in Minnesota
## Share of 2003 Seeded Acres by Crop District

| VARIETY | NORTHERN %[1] | CENTRAL %[1] | SOUTHERN %[1] | TOTAL STATE %[1] | STATE ACRES (1,000) |
|---|---|---|---|---|---|
| Oxen | 10.8 | 51.9 | 65.3 | 25.9 | 478.9 |
| Alsen | 22.6 | 7.0 | 0.6 | 16.8 | 310.6 |
| Reeder | 15.0 | 2.9 | 0.0 | 10.5 | 194.1 |
| Parshall | 12.9 | 3.4 | 2.3 | 9.4 | 173.8 |
| Walworth | 7.1 | 13.5 | 8.7 | 9.3 | 172.0 |
| Ingot | 5.2 | 6.3 | 4.2 | 5.6 | 103.5 |
| Briggs | 4.5 | 4.4 | 3.4 | 4.5 | 83.2 |
| Norpro | 4.8 | 1.6 | 1.7 | 3.6 | 66.6 |
| Knudson | 3.7 | 1.6 | 2.1 | 2.9 | 53.6 |
| 2375 | 2.6 | 1.2 | 3.3 | 2.2 | 40.7 |
| Granite | 1.9 | 0.3 | 0.7 | 1.4 | 25.9 |
| Mercury | 1.6 | 0.7 | 2.3 | 1.3 | 24.0 |
| Other[2] | 7.4 | 5.3 | 5.4 | 6.6 | 122.0 |
| | | 1,000 ACRES | | | |
| All Varieties | 1,091 | 648 | 111 | 1,849 | 1,849 |

1/Columns may not add to 100 due to rounding. 2/Includes varieties with less than 1% of acreage in 2003 and unknown varieties.

## Spring Wheat Varieties in South Dakota
## Share of 2002 Seeded Acres by Crop District

| VARIETY | NORTH WEST %[1] | NORTH EAST %[1] | SOUTH EAST %[1] | SOUTH WEST %[1] | TOTAL STATE %[1] | STATE ACRES (1,000) |
|---|---|---|---|---|---|---|
| Oxen | 11.5 | 28.4 | 17.5 | 23.9 | 23.3 | 396.1 |
| Russ | 23.1 | 21.2 | 13.9 | 9.6 | 18.4 | 312.5 |
| Forge | 9.7 | 10.6 | 32.2 | 23.8 | 16.8 | 285.2 |
| Ingot | 2.1 | 14.7 | 18.2 | 1.6 | 12.0 | 204.6 |
| Walworth | 3.8 | 6.2 | 1.6 | 0.0 | 4.1 | 69.4 |
| Butte 86 | 7.9 | 1.5 | 4.6 | 9.6 | 4.1 | 69.3 |
| Reeder | 5.5 | 3.2 | 0.0 | 0.0 | 2.4 | 40.6 |
| Alsen | 1.3 | 2.3 | 0.6 | 0.8 | 1.6 | 27.7 |
| Sharp | 0.4 | 0.9 | 1.2 | 2.8 | 1.1 | 19.5 |
| Norpro | 0.5 | 1.5 | 1.0 | 0.0 | 1.1 | 18.0 |
| Trenton | 7.0 | 0.1 | 0.1 | 0.0 | 1.0 | 16.7 |
| Other[2] | 27.2 | 9.4 | 9.0 | 27.8 | 14.1 | 240.4 |
| | | | 1,000 ACRES | | | |
| All Varieties | 224 | 893 | 354 | 229 | 1,700 | 1,700 |

1/Columns may not add to 100 due to rounding. 2/Includes varieties with less than 1% of acreage in 2003 and unknown varieties.

# handling & transportation

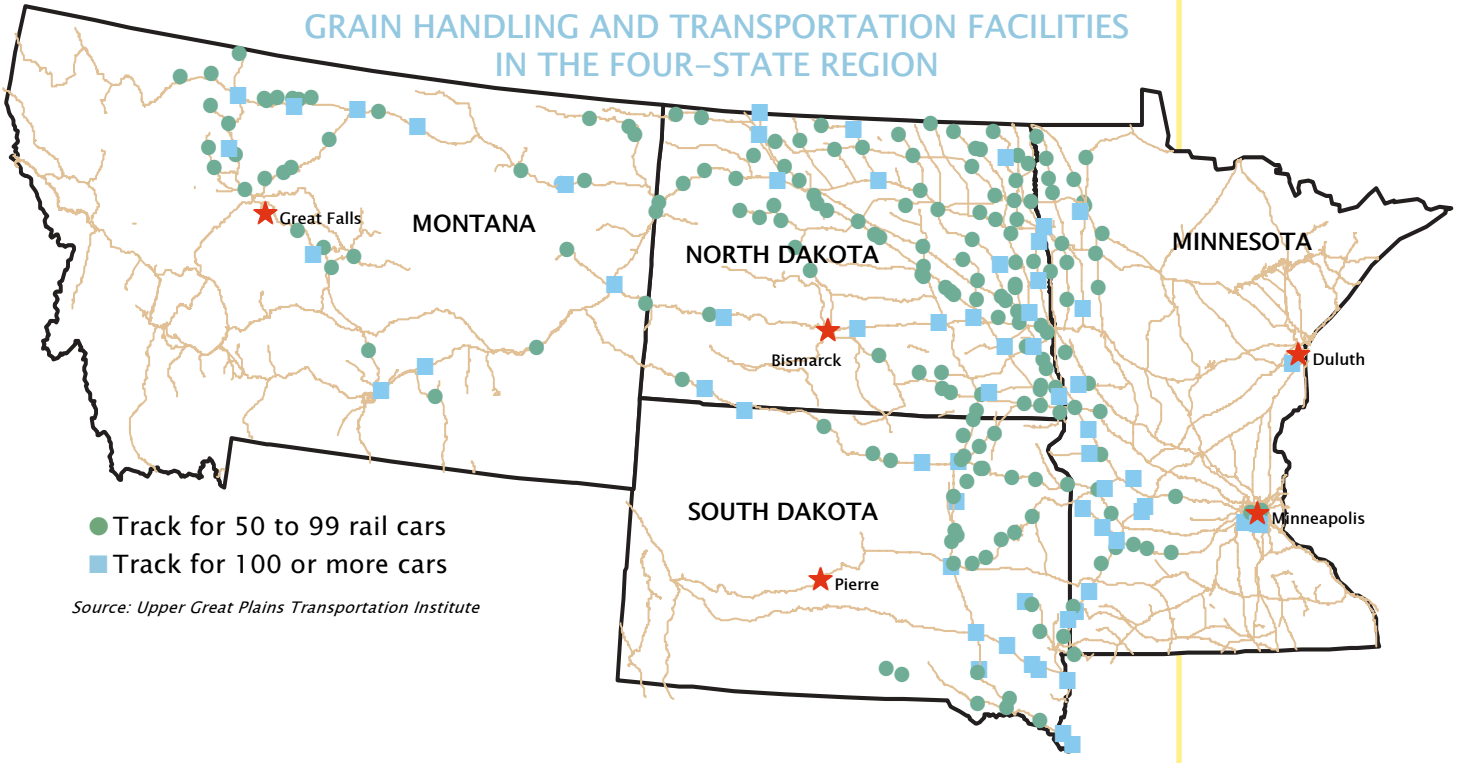
The hard red spring wheat growing region in the Northern Plains has a vast network of country elevators to facilitate efficient and precise movement to domestic and export markets. On average, nearly 80 percent of the region's wheat moves to markets by rail. Duluth is the only export market serviced by a greater share of trucks. Shipments to the Pacific Northwest and Gulf export markets are almost entirely by rail, with some barge movement to the Gulf. The dominant railroad is the Burlington Northern Santa Fe, followed by the Canadian Pacific.

A majority of the elevators in the region have the ability to ship 50 railcar units, with several equipped to ship 100 car units. Each rail car holds approximately 3,500 bushels (95 metric tons) of wheat. Some of the 100-car shippers have invested in "shuttle" capabilities. Shuttle-equipped facilities receive the lowest rates, sharing volume and transaction efficiencies with the railroad.

The diverse rail shipping capacities and widespread network of elevators are strengths buyers can capitalize on, especially as their demand heightens for more precise quality specifications and consistency between shipments. Buyers are increasingly exploring origin-specific shipments. Many international buyers now find it possible to request wheat from certain locations to optimize the quality and value of wheat they purchase.

The rail and elevator network in the U.S. hard red spring wheat region is well suited for meeting the increasing quality demands of both domestic and international customers.

GRAIN HANDLING AND TRANSPORTATION FACILITIES IN THE FOUR-STATE REGION




*Source: Upper Great Plains Transportation Institute*

## FUNDING & SUPPORT

North Dakota Wheat Commission

Montana Wheat and Barley Committee

Minnesota Wheat Research and Promotion Council

South Dakota Wheat Commission

U.S. Wheat Associates